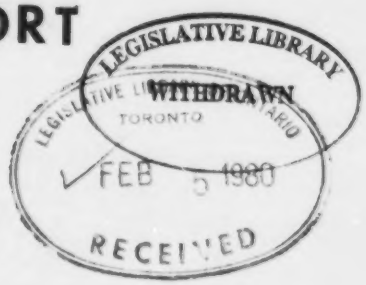
THIRD

ANNUAL REPORT

1977 – 78



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Alberta
ENVIRONMENT

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15th Floor, Oxbridge Place
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ALBERTA OIL SANDS ENVIRONMENTAL RESEARCH PROGRAM

The Alberta Oil Sands Environmental Research Program was established by agreement between the Governments of Alberta and Canada in February 1975 (amended September 1977). This 10-year program is designed to direct and co-ordinate research projects concerned with the environmental effects of development of the Athabasca Oil Sands in Alberta.

Additional copies of this Third Annual Report are available on request. Enquiries pertaining to the Canada-Alberta Agreement or research reports for AOSERP should be directed to:

Alberta Oil Sands Environmental Research Program
15th Floor, Oxbridge Place
9820 - 106 Street
Edmonton, Alberta
T5K 2J6
(403) 427-3943

Third Annual Report

1977-78

AOSERP Report 32

This report may be cited as:

Alberta Oil Sands Environmental Research Program. 1978. Third Annual Report, 1977-78. AOSERP Report 32. 144 pp.

The Hon. D.J. Russell
Minister of the Environment
Legislative Building
Edmonton, Alberta

and

The Hon. L. Marchand
Minister of State for the Environment
Fisheries and Environment Canada
Ottawa, Ontario

Sirs:

Enclosed herein is the Third Annual Report on the Alberta Oil Sands Environmental Research Program, for the year 1 April 1977 to 31 March 1978.

This document contains information about the organization, direction, and objectives of the Program as well as concise summaries of the research projects conducted under the auspices of the Program in the third year of its operation, under the Canada-Alberta Agreement of February 1975 (amended September 1977).

Respectfully,

W. Solodzuk, P.Eng.
Chairman, Steering Committee, AOSERP
Deputy Minister, Alberta Environment

A.H. Macpherson, Ph.D.
Member, Steering Committee, AOSERP
Regional Director-General
Environmental Management Service
Fisheries and Environment Canada

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MESSAGE FROM THE STEERING COMMITTEE CHAIRMAN

The Alberta Oil Sands Environmental Research Program (AOSERP) underwent a period of consolidation and reorientation during its third year. The Canada-Alberta Agreement between the Departments of the Environment for Alberta and Canada was amended in September 1977. The amended agreement provided for centralized research management and direction as well as financial control and administration. Program Management for AOSERP was realigned to assume these responsibilities through the appointment of a new Program Director, Dr. Stuart B. Smith, an Assistant Director, four System Research Managers (Air, Human, Land, and Water) and an Operations Manager.

Under authority of the amended Canada-Alberta Agreement, a Senior Advisory Board was created. The Board is composed of senior management representatives of involved Federal and Provincial departments. Responsibilities of the Board include providing advice to the Steering Committee on the relevance and timeliness of existing and proposed research efforts, purpose, objectives, and priorities of the research program, and areas of interrelationship with research programs other than those provided for in the Canada-Alberta Agreement. The Senior Advisory Board met four times during the year. The amended Canada-Alberta Agreement is attached as Appendix I.

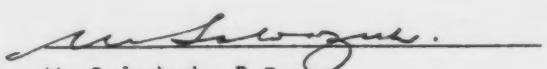
The third year of the Program has witnessed fulfilment of the recommendations made and objectives set forth in the second year for more effective integration and co-ordination of research through centralized research management and direction. This was acknowledged at the Senior Advisory Board meeting of 24 January 1978, when it was apparent from the amended Canada-Alberta Agreement, Policy and Direction document, Program Research Plan, and active Scientific Advisory Committees that the Program was on the right track.

A major concern surfaced during the year with respect to

public awareness of AOSERP and dissemination of research findings by the Program. This deficiency was rectified by appointment of a Publications Officer in charge of report preparation and editing, communications, and public relations for the Program. Concurrent with this action, a Reporting Policy for AOSERP contractors was approved by the Steering Committee to reinforce the commitment of government departments, universities, research institutions, and private consultants to report on research projects in an acceptable manner.

During January of 1978 the Steering Committee and Program Management for AOSERP met with a group representing various Federal government departments in Ottawa. The purpose of this meeting was to brief several Federal departments on the status and future direction of AOSERP.

The Steering Committee held monthly meetings during the year in providing policy level direction to the Program Director. As Chairman of the Steering Committee, I wish to thank my colleagues Mr. J.P. Bruce as the Member for Canada and Dr. A.H. Macpherson as the Alternate Member for Canada for their assistance and co-operation during the year. We support the hard work and dedication of Program Management staff in administration of a multi-disciplinary environmental research program which is unique in Canada. The contributions of researchers, and numerous participants and advisors are also acknowledged.



W. Solodzuk, P.Eng.
Chairman, Steering Committee
Alberta Oil Sands Environmental
Research Program

REPORT OF THE PROGRAM DIRECTOR

During the early part of 1977 a significant change took place in the administration of the Alberta Oil Sands Environmental Research Program. Responsibility for design, review, and initiation of investigations was transferred from the eight Technical Research Committees to Program Management for AOSERP. Use of peer review and referees was increased, in order to improve evaluation of research results and the quality of AOSERP publications. Transfer of management authority from technical committees to Program Management followed approval by the Ministers of Environment for Canada and Alberta for a system which could better optimize the cost/effectiveness of the Program, as well as allow more direct application of research management planning.

Following the appointment of the undersigned as Program Director effective 24 May 1977, heavy emphasis continued on administrative reorganization of the Program, critical evaluation of research results, identification of deficiencies in research knowledge concerning baseline states in the AOSERP study area, and publication of a Policy and Direction document for the Program. Orientation of research effort was changed from involvement of eight Technical Research Committees as provided for in the original Canada-Alberta Agreement for AOSERP, signed in February 1975, to an approach involving four systems (Air, Land, Water, and Human) and four Scientific Advisory Committees, transmitting recommendations directly to Research Managers and the Program Director. Roles for Scientific Advisory Committees and Program Management of AOSERP have now been clearly separated, which involves independent scientists in the scientific conduct of the Program and makes AOSERP managers directly responsible for the operational management of research. A two-day meeting was held with all Scientific Advisory Committee members in January 1978 resulting in a consensus by scientists on the main aspects of program planning by AOSERP.

The revised mandate for the Alberta Oil Sands Environmental Research Program is contained in the amended Canada-Alberta Agreement, signed by the Ministers of Environment for Canada and Alberta in September 1977. The management structure for AOSERP previously specified in the Agreement has been deleted, to be replaced by authority for the Program Director to appoint scientific advisors as required. No change has been made in the termination date of the first five years of the Program, which, unless the Agreement between Canada and Alberta is renewed, ends on 31 March 1980.

Particular attention is being given to evaluation of progress toward three-year and five-year objectives for the Program, laid down in the AOSERP Policy and Direction document approved by Canada and Alberta, and published in November 1977. The three-year objectives of reviewing existing data and identifying knowledge gaps relating to the effects of oil sands development largely have been met. Research projects have been established and monitoring networks have been set up in the Air and Water systems to monitor air and water quality. Identification of social and environmental problems relating to oil sands development is an ongoing task, now involving the Scientific Advisory Committees for Air, Land, Water, and Human systems. No integrated data storage and retrieval system yet exists for AOSERP.

Proposals have been evaluated for development of a comprehensive data handling, storage, and retrieval system, the incompleteness of which is seen as a Program deficiency. A conceptual design for integration of AOSERP research has been discussed, but progress in this area also is viewed as being deficient. Program Management made a commitment for a report summarizing the current status of AOSERP that is to be presented to the Steering Committee and Senior Advisory Board before December 1978. This report is now in the planning stage, and will be intended to document all available information on baseline states of the environmental system in the AOSERP study area, as well as

to describe perceived deficiencies and knowledge gaps which require remedial action by 1980.

The legal termination of the first five years of the Canada-Alberta Agreement for AOSERP in 1980 requires that Program Management develop scenarios for the governments of Canada and Alberta that can be applied to the transfer of knowledge and technology to regulatory agencies, as well as to the need or otherwise for the continued presence of the Program in the oil sands region. Construction of an adequate data storage and retrieval system, operation of air quality and water quality networks, and conceptual design of integrated models for environmental management of the area all have received study during the past year. Such factors will form the major elements for consideration of recommendations for possible scenarios relating to AOSERP in 1980.

Considerable effort was devoted in 1977 to development of an AOSERP-industry model for co-operative research in the Athabasca Oil Sands region. Several areas of research (reclamation, wildlife, fisheries, air and water pollution, social research) are of joint interest to AOSERP and oil sands companies. A model for co-funding of environmental research of joint concern has therefore been passed to industry and its consultants for comments. To date response has been positive, and several projects are under active consideration for co-funding. The AOSERP-industry model is contained in Appendix II.

The past year has been heavily occupied with administrative reorganization and scientific reorientation of AOSERP. Advice has been sought widely from Alberta and Canada government departments, research institutions, universities, industry, and private environmental research consultants in an effort to provide program orientation and relevance. No major impediment now exists to completion of the Program under the five-year Canada-Alberta

Agreement for AOSERP. The status of AOSERP reports is summarized in Appendix III.

S.B. Smith, Ph.D.
Program Director

PROGRAM SUPPORT SERVICES

AOSERP is managed by a Program Management team, a small group of professionals who work under the auspices of the Alberta Department of Environment. In addition to the four research systems (Air, Human, Land, and Water), there is an Operations Group managed by an Operations Manager who is responsible for general administration of the Program and operational aspects of the research. Under the Canada-Alberta Agreement, administration of AOSERP is assigned to the Alberta Department of Environment. Cost of administration is borne equally by Canada and Alberta.

Research projects authorized for funding are undertaken by contractual agreement between AOSERP and government agencies, research institutions, universities, or private consultants. During the 1977-78 fiscal year contracts were administered by Program Management, provincially through Alberta Environment and federally through the Federal Department of Supply and Services, depending on the source of funds. During the 1978-79 fiscal year most contracts will be handled through Alberta Environment. Projects carried out by Federal and Provincial line agencies are handled through letters of agreement signed between the Steering Committee for AOSERP and senior management representatives of the respective line agencies.

In the early stages of the Program, investigations were carried out predominantly by government agencies; however, the emphasis is now heavily on contract research, split approximately equally between universities and the private sector. Distribution of funds to government agencies, universities, and the private sector is shown in Table 1.

The 1977-78 budget was set at $4,000,000 by Federal-Provincial agreement; Canada and Alberta each contributed $2,000,000. A financial report for the year is provided in Table 2. During the 1977-78 fiscal year, 66 research projects were approved and implemented. Research funded in the four systems was

Table 1. Distribution of AOSERP research project funds during the years 1975-76, 1976-77, 1977-78, and 1978-79.

Recipient	Year							
	1975-76		1976-77		1977-78		1978-79[a]	
	Amount (approx.)	%	Amount (approx.)	%	Amount (approx.)	%	Amount (approx.)	%
Government	$2,872,298	82	$3,230,368	72	$2,057,275	62	$1,506,700	48
University	302,707	9	788,017	18	468,822	14	187,000	6
Consultant	340,954	10	481,615	11	785,808	24	1,478,000	47

[a]Projected distribution.

Table 2. AOSERP financial reports, 1975-76, 1976-77, and 1977-78.

Fiscal Year	System	FEDERAL		PROVINCIAL	
		Budget	Expenditure	Budget	Expenditure
1975-76	Human	-	-	$ 58,000.00	$ 35,713.00
	Water	$998,000.00	$442,932.00	737,000.00	158,501.00
	Land	286,000.00	197,247.00	1,078,000.00	951,940.00
	Air	716,000.00	529,800.00	347,000.00	119,842.00
	Program Management	-	-	280,000.00	947,655.00
	TOTAL	$2,000,000.00	$1,169,979.00	$2,500,000.00	$2,213,651.00
1976-77	Human	-	-	$ 131,000.00	$ 64,974.00
	Water	$735,000.00	$490,737.00	362,000.00	322,067.00
	Land	590,000.00	366,518.00	1,284,000.00	1,031,711.00
	Air	573,000.00	470,674.00	357,000.00	307,300.00
	Program Management	102,000.00	-	366,000.00	528,295.00
	TOTAL	$2,000,000.00	$1,327,929.00	$2,500,000.00	$2,254,347.00
1977-78	Human	-	-	$ 140,000.00	$ 38,520.00
	Water	$ 767,353.00	$ 701,707.00	271,300.00	207,332.00
	Land	248,775.00	226,412.00	1,086,878.00	652,493.00
	Air	495,900.00	406,245.00	272,970.00	204,295.00
	Program Management	487,972.00	10,084.00	888,852.00	1,074,373.00
	TOTAL	$2,000,000.00	$1,344,448.00	$2,660,000.00	$2,177,013.00

as follows: Air, 22%; Human, 4%; Land, 38%; and Water, 30%. Program Management budget for the year was initially 13% but was augmented through a special warrant from the Alberta Government to offset monies disbursed on behalf of the Federal Government and recovered as Provincial General Revenue. During the 1977-78 fiscal year funding levels among government agencies, private consultants, and universities were 62%, 24%, and 14%, respectively.

The AOSERP Mildred Lake Research Facility, located approximately 48 km north of Fort McMurray, provides accommodations, meals, and field laboratory and storage facilities for AOSERP researchers. During 1977-78, 18,163 meals and 5,773 overnights were provided by a contract caterer (Bull Caterers Ltd.) in a camp-style kitchen. A program helicopter on contract from Liftair International is based at the facilities. The helicopter provided 791.6 hours during 1977-78 in support of research activities. In addition, 856.6 hours of fixed-wing aircraft time were provided.

The AOSERP Field Office in Fort McMurray moved to new and larger premises during the year to provide the Program with much-needed office and warehouse space. During the 1977-78 fiscal year Program Management assumed the responsibility for inventory control and maintenance of field equipment. A warehouse person was hired and procedures were commenced to inventory and issue field equipment from the Fort McMurray warehouse. In addition to the warehouse, the facility provides an office for the Field Manager and workspace for researchers and technicians working on AOSERP research projects. The Fort McMurray office also serves as the focal point for field operations, including a base station for field communications with the Program VHF radio communication system.

Program Management for AOSERP also initiated three projects involving contracts with private consultants during the year. Details on these projects are provided in the following summaries.

Field operations for AOSERP research are carried out in the AOSERP study area (Figure 1).

P.S. Grant
Operations Manager

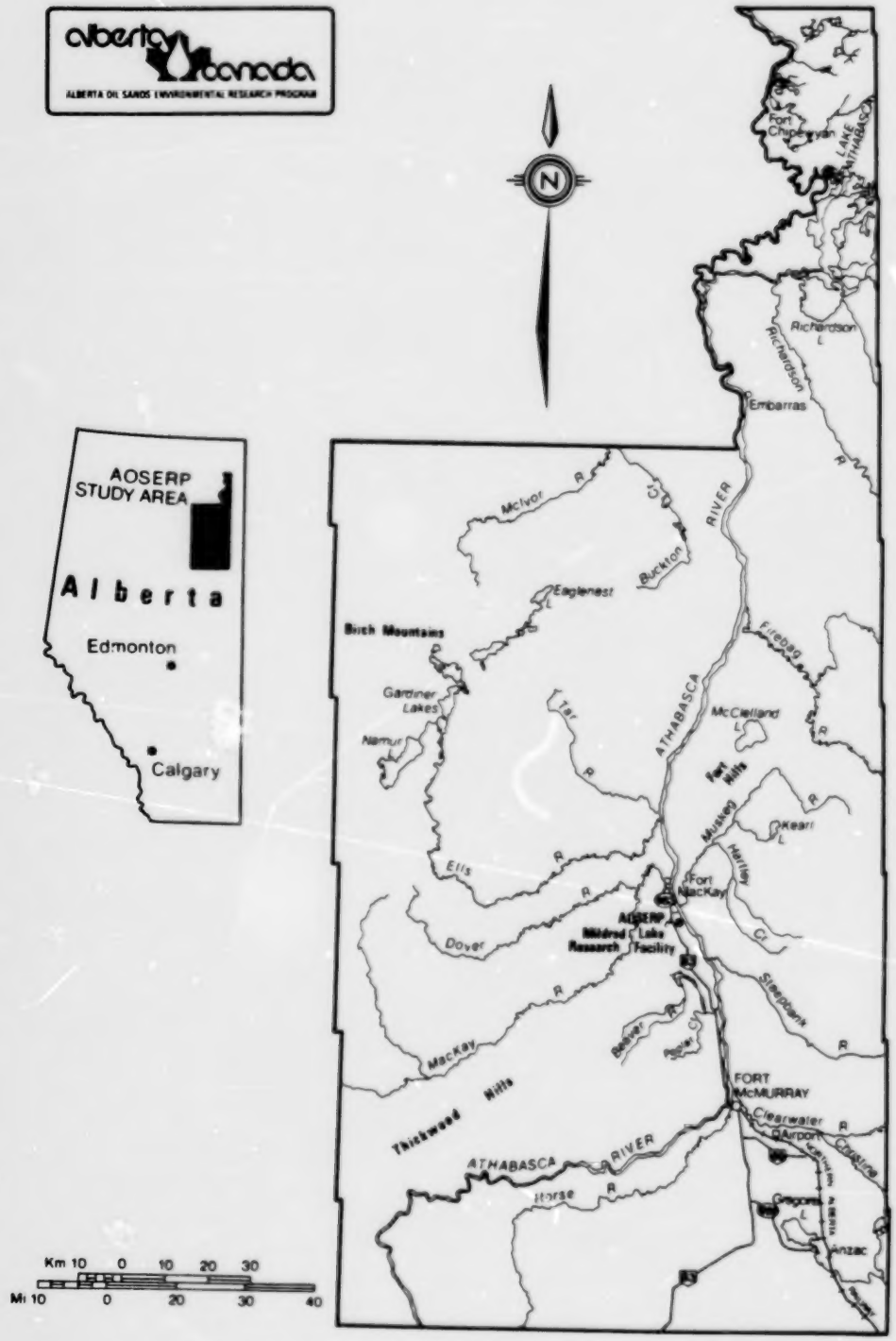


Figure 1. The Alberta Oil Sands Environmental Research Program study area.

Program Support Services Projects

Data Management for the Alberta Oil Sands Environmental Research Program

RESEARCHER: To be defined

AFFILIATION: To be defined

DESCRIPTION:

The Canada-Alberta Agreement for AOSERP specifies that "the purpose of the Program is to provide timely information about factors that will aid the parties in establishing guidelines . . ." but does not define how the information is to be provided nor the form in which it is to be presented. This purpose is repeated in the AOSERP Policy and Direction document, and more definition of a three-year Program objective is provided: "to promote the establishment of an integrated data storage and retrieval system encompassing all information pertinent to the Program and ensure that all data generated through the Program is placed in the data system." This project is intended to provide a data management system(s) appropriate to AOSERP by defining information requirements, identifying alternate approaches to data management systems, and outlining a data management system(s) that may be adopted.

OBJECTIVES:

The objectives of this project were to define the existing and potential information management requirements for the Alberta Oil Sands Environmental Research Program, and to review available data management systems and evaluate various alternatives for implementation of systems appropriate to the needs of the Program.

STATUS:

During 1977-78, terms of reference were drafted and the project was approved by the Steering Committee for AOSERP. Proposals were requested from several consulting firms in March 1978. These proposals will be evaluated early in the 1978-79 fiscal year and a contract will be awarded to the successful company.

REPORT:

A final report will be required upon completion of the project.

Toxicology Program Research Design

RESEARCHERS: R.B. Murray, T. Jantzie, P. Nix, B. Croft, Dr. R.T. Coutts, Dr. D.F. Biggs, and Dr. A.A. Loman

AFFILIATION: Chemical and Geological Laboratories Ltd.

DESCRIPTION:

Toxicology research has been carried out under the auspices of AOSERP as well as the oil sands industry (Syncrude Canada Ltd.). Within AOSERP such research has been primarily centred around the Water System. However, a thorough problem analysis and conceptualization of toxicology problems was never carried out. This project was, therefore, implemented to design a program of toxicology research appropriate to the objectives of AOSERP, the four systems (Air, Land, Water, and Human), oil sands development, and defined needs.

OBJECTIVE:

The objective of this project was to design a program of toxicology research for the Alberta Oil Sands Environmental Research Program.

STATUS AND REPORT:

A draft of the final report was received in February 1978 and is presently under review by Program Management for AOSERP. The report addresses the following areas:

1. A review of the nature and magnitude of present and proposed oil sands development effluents and emmissions from the AOSERP study area.
2. A review of the results of previous and ongoing studies of quality of waste and receiving water undertaken by or for government, industry, and AOSERP.
3. A review of the results of previous and ongoing toxicology studies undertaken by or for government, industry, and AOSERP.
4. A description of the physical and chemical characterization of oil sands development wastes and an outline of toxicological significance of the wastes to the biota of the AOSERP study area.
5. A user summary outlining the needs for a program of toxicology research by government, industry, and AOSERP.

Evaluation of the Hydraulic, Suspended Sediment, and Water Quality Networks in the AOSERP Study Area

RESEARCHER: E.K. Yaremko, P.Eng.

AFFILIATION: Northwest Hydraulics Consultants Ltd.

DESCRIPTION:

The purpose of these three networks was to provide information on the baseline regimes of streamflow, lake-level, and water quality for the AOSERP study area, and to assist in the prediction of disturbed regimes. This is in keeping with the purpose and three-year objectives of AOSERP. Because 1977-78 is the third year of the Program, it was deemed necessary to evaluate the water quantity and water quality networks in relation to Program needs as the focus changes from evaluation of baseline states to that of applied research.

OBJECTIVE:

The general objective was to evaluate the present hydrometric, suspended sediment, and water quality networks in the AOSERP study area, evaluating current data, to provide the basis for continuation and/or redirection of these networks.

STATUS AND REPORT:

A final camera-ready copy of the report has been received for publication by AOSERP. The report includes an assessment of the existing baseline hydrometric and water quality networks in terms of their areal extent and the adequacy of available information. The merits of providing a criteria to be used to assess the hydrometric and water quality networks and information on an ongoing basis are discussed. Some suggestions are given with respect to the possible characteristics of a stage-two (second-order) hydrometric or water quality network; reasons for recommending specific station locations are provided.

Terms of reference for 1978-79 projects involving water quantity and water quality monitoring have been modified according to the recommendations of the final report.

AIR SYSTEM
RESEARCH ACTIVITIES, 1977-78

The Alberta Oil Sands Environmental Research Program has been established to provide information that will permit the orderly development of oil sands resources without undue damage to the environment of the region. The Air System is concerned with processes by which pollutants enter the atmosphere, are transported and dispersed by air movement, undergo chemical changes, and are ultimately removed by dry fallout and precipitation.

Research in the Air System is directed toward an understanding of physical and chemical processes affecting air pollution dispersion in the study area. Objectives of the Air System are:

1. To establish and operate data acquisition systems to describe existing air quality conditions and meteorological processes;
2. To describe major meteorological and air quality characteristics of the study area based on historical and current data;
3. To study processes of air pollution dispersion, chemical transformation, transport, and deposition within the study area.
4. To develop systems for predicting levels of air pollution resulting from oil sands processing and the extent of pollutant dispersion and impingement on land and water; and
5. To provide advice and scientific support to other research sectors in areas relating to meteorology and air quality.

To meet these objectives, a program of research studies has been designed to establish meterology and air quality data acquisition systems; to arrange for intensive field studies in which scientists examine atmospheric processes in detail for short periods during different seasons; to initiate studies of physical

conditions and processes such as background air chemistry, magnitude of fog occurrence, chemical transformation, and deposition processes; and to predict the impact of air pollution on the region by means of modelling these various processes.

The research program is organized so that feasibility studies, field studies, and literature reviews are carried out in the early phases of the research effort. The knowledge gained from these research activities is then applied to more complex projects designed to integrate the results of several studies. The goal of the program is to establish the physical characteristics of all basic processes by the fifth year so that environmental effects of oil sands development can be predicted and an operational model can be constructed for future management of air quality in the airshed of the region.

A.S. Mann
Research Manager
Air System

Air System Projects

ME 1.1, 1.2, 1.3, and 1.4 Meteorology Data Acquisitions: ME 1.1 Meteorology Tower ME 1.2 Meteorological Network ME 1.3 Mobile Minisonde ME 1.4 Precipitation Chemistry

RESEARCHER: B. Janz

AFFILIATION: Atmospheric Environment Service, Western Region, Edmonton

DESCRIPTION:

This project comprised four data acquisition activities: climatological network of nine remote stations that transmitted data to the base station at the AOSERP Mildred Lake Research Facility; meteorological tower at Lower Syncrude which recorded temperature at five levels and wind at three levels up to 152 m; minisonde program--twice daily for temperature profiles; and precipitation chemistry network in which samples collected from 14 sites in the area were analyzed for chemical constituents. All data were processed and archived by the Atmospheric Environment Service AOSERP group in the Western Region.

OBJECTIVE:

The objective of this project was to establish and operate systems for collecting and processing meteorological data from the AOSERP study area that are required for Air System research and by researchers in other sectors.

STATUS:

The entire data acquisition system for meteorology was operational throughout the year. Data were routinely processed by the AOSERP field operations group of Atmospheric Environment Service and data are available on request.

REPORT:

An interim report on the climatology of the AOSERP study area has been prepared; it is currently in review and will be published by October 1978. The report includes reference to topographic climatological controls and compares the climate of the AOSERP study area with that in other parts of Alberta.

ME 1.5.3
Air System Summer Field Study in the AOSERP Study Area, June 1977

RESEARCHERS: Dr. F. Fanaki (co-ordinator), Dr. L.A. Barrie, Dr. M. Lusis, Dr. R.E. Mickle, and Dr. R.M. Hoff

AFFILIATION: Atmospheric Environment Service, Downsview

DESCRIPTION:

This study included a number of special measurement programs designed to more precisely describe the meteorology and air quality processes in the AOSERP study area.

OBJECTIVE:

The objective of this project was to examine in detail the air quality characteristics of the AOSERP study area under summer conditions, particularly as they relate to plume behaviour and dispersion. The main emphasis in this case was on the chemistry of the plume, its constituents, oxidation rate of sulphur dioxide (SO_2), and composition of particulates.

STATUS:

The study was successfully carried out over a period of two weeks in the latter part of June; support data were acquired by means of minisondes, tethersonde, two acoustic sounders, LIDAR for examining plume configurations, and by the correlation spectrometer by which a profile of total SO_2 in the plume could be identified. Plume rise measurements were made by photogrametric means.

This study was co-ordinated with two other concurrent measurement programs: a plume chemistry study (ME 3.5.2) and a plume survey (ME 2.3.2).

Although the final report has not been completed, preliminary evaluations of the study indicate that LIDAR is a viable means of determining plume configuration, and the results show valley effects and wind shear under stable conditions to be important considerations for that area. The experimental determination of deposition rates for a variety of particulates also yielded valuable new information. It was possible, through measurements at fifteen points, to identify the deposition amounts for each element and to separate those emanating from natural sources from those of anthropogenic origin.

REPORT:

The final report for this project, which was due in January 1978, has not been received.

ME 2.1
Air Quality Data Acquisition

RESEARCHER: M. Strosher

AFFILIATION: Pollution Control Division, Alberta Environment

DESCRIPTION:

This project provided for the acquisition, processing, and archiving of all air quality data in the AOSERP study area.

OBJECTIVE:

The objective of this project was to establish and operate stations for monitoring chemical constituents of the atmosphere in the AOSERP study area. The information collected will provide a better understanding of the natural air chemistry of the area and may indicate the nature of changes due to urban and industrial development.

STATUS:

Data were acquired from three main monitoring stations at Birch Mountain, Bitumount, and Fort McMurray throughout the year. These stations routinely measured sulphur dioxide, ozone, and particulates. In addition, the Fort McMurray and Bitumount stations measured hydrogen sulphide, carbon monoxide, and oxides of nitrogen. Among the metals measured in the particulate samples were lead, copper, manganese, chromium, mercury, zinc, berylium, vanadium, nickel, molybdenum,and cobalt.

Data from these stations were processed on a regular basis by the facilities of Alberta Environment. Data from some 10 industry-operated sites are also processed in a similar manner.

REPORT:

The interim report for this project has been received, reviewed, and distributed.

ME 2.2
Inventory of Sources and Emissions in the AOSERP Study Area

RESEARCHER: W. Shelfentook

AFFILIATION: SNC Tottrup Services Ltd.

DESCRIPTION:

This project set up an inventory system for and acquired data on all gaseous and particulate emissions in the study area for 1976.

OBJECTIVES:

The objectives of this project were: to design an inventory system for gaseous and particulate emissions in the AOSERP study area and to implement the system for data collected during 1976; and to prepare a publication describing how the inventory system was prepared and how it can be used.

STATUS:

The study started in 1976 and in early 1977 was in an advanced state of preparation. The sources and rate of emissions of all known atmospheric emissions in the AOSERP study area, both man-made and natural, were calculated or estimated and inserted into the inventory.

REPORT:

The final report for this project, "An Inventory System for Atmospheric Emissions in the AOSERP Study Area", has been received and distributed. This report outlines how the system works and gives examples of the types of information that can be produced.

ME 2.3.2
Plume Dispersion Measurements from an Oil Sands Extraction Plant, June 1977

RESEARCHERS: Dr. D.S. Davison and K.L. Grandia

AFFILIATION: INTERA Environmental Consultants Limited

DESCRIPTION:

Measurements of the geometry of the GCOS plumes were carried out by means of transects with air-borne instruments.

OBJECTIVE:

The objective of this project was to determine the behaviour and configuration of existing plumes from the Great Canadian Oil Sands plant by means of aerial measurements.

STATUS:

This study was carried out during the Air System Summer Field Study in June 1977 and measurements were successfully made on representative summer plume configurations. Four flights were selected for detailed analysis of plume geometry and turbulence characteristics. The turbulence data were applied to statistical theory for lateral dispersion and gave remarkably good agreement, except for one flight. Vertical plume spread is not well predicted by this procedure, however. The report suggests that a better knowledge of initial plume-induced turbulent mixing, changes in stability with heights, and changes in integral scales would lead to better predictive accuracy.

REPORT:

A draft final report has been received and is in review.

ME 3.2
Background Air Quality in the AOSERP Study Area

RESEARCHER: Dr. L.A. Barrie

AFFILIATION: Atmospheric Environment Service, Downsview

DESCRIPTION:

This project provided for: the ongoing chemical analysis and evaluation of precipitation samples collected in the AOSERP study area; carrying out field projects to collect air samples for the identification of background levels of atmospheric constituents; and a short-term study to evaluate dry deposition rates in the study area.

OBJECTIVES:

The objectives of this project were: to determine the composition and atmospheric concentrations of background suspended particulates at Birch Mountain for summer and winter periods; to determine the chemical constituents in snow within 30 km of Mildred Lake and at a distance of approximately 100 km, for comparison; and to compare the results of these sampling programs to those in other areas of Canada.

STATUS:

The objectives of this project were achieved. This study has resulted in the establishment of a one-year monitoring program for suspended particulates under background conditions.

REPORT:

The interim report, which was due in March 1978, is now overdue.

ME 3.5.2
SO_2 Oxidation in the Plumes from the GCOS Extraction Plant under Summer Conditions

RESEARCHER: Dr. M. Lusis

AFFILIATION: Atmospheric Environment Service, Downsview

DESCRIPTION:

This project included the acquisition and interpretation of data relating to oxidation rates of sulphur dioxide to particulate sulphates in the GCOS plumes. The study was carried out during the Air System Summer Field Study, June 1977.

OBJECTIVES:

The objectives of this project were: to experimentally examine the summertime rates of oxidation of SO_2 to sulphuric acid and sulphates in the GCOS plumes; to obtain in situ measurements of SO_2 plume dispersion coefficients as a function of downwind distance under summer conditions; to examine photo-chemical aspects of SO_2 oxidation; and to compare relative diffusion characteristics of SO_2 and particulates.

STATUS:

The project was successfully carried out in June 1977. Plume transects were flown at several downwind distances up to 40 km from GCOS by an instrumented helicopter. Sulphur dioxide dispersion rates were measured and oxidation rates were determined by means of specially designed filter pack samplers. Supporting solar irradiance, radiosonde, and minisonde measurements were made from the ground. SO_2 oxidation rates were found to be low during early morning flights, similar to those of February, which were typically less than 0.5%/h. Later in the day appreciable oxidation was observed, approximately 1-3%/h. A downwind ozone "bulge" was noted on several afternoons. Results suggest photochemical processes play an important part in the oxidation of SO_2.

REPORT:

The report on this project will be included in the Air System Summer Field Study, June 1977 report. This final report, which was due in March 1978, has not been received.

ME 3.5.4
Plume Chemical Reaction--
Modelling and Verification

RESEARCHERS: Dr. O.P. Strausz and Dr. J. Bottenheim

AFFILIATION: Hydrocarbon Research Centre, University of Alberta

DESCRIPTION:

The project is designed to develop a comprehensive computer algorithm describing the chemical fate of pollutant gases from the oil sands development process.

OBJECTIVES:

The objectives of this project were: to develop a compact model incorporating the salient features of the chemistry of sulphur dioxide, oxides of nitrogen, ozone, and hydrocarbons and to validate these by means of smog chamber experiments; to combine the resulting chemical model with a Gaussian plume dispersion model which allows for gradual entrainment of ambient air; and to interpret data on existing plumes from oil sands extraction plants.

STATUS:

The project was started in February 1978. The first interim report indicates that good progress is being made identifying major features of chemical reaction in the plume. Because this project is expected to continue through 1978, smog chamber experiments and more rigorous modelling will follow.

REPORT:

The interim report for this project has been received and is in review.

ME 3.6
Literature Review on Pollutant Deposition Processes

RESEARCHER: P.J. Denison

AFFILIATION: Acres Consulting Service Ltd.

DESCRIPTION:

This project included a documented literature review, recommendations on relevant pollutant deposition formulations, and recommendations for validation of selected processes by means of field measurements.

OBJECTIVES:

The objectives of this project were: to discuss the current state of knowledge on wet and dry deposition processes; to select appropriate details of physical models that may be applied to the AOSERP study area; and to prepare a field measurement project to validate these processes.

STATUS:

The consultant has completed an extensive literature review and at the end of the fiscal year was engaged in selecting and documenting those formulations which were appropriate for application in the area.

REPORT:

The final report on the study has been received and is now in review.

ME 3.7
Low Temperature Fog Observations

RESEARCHER: B. Janz

AFFILIATION: Atmospheric Environment Service, Western Region, Edmonton

DESCRIPTION:

This study was designed to obtain field observations of fog occurrence at low temperatures (-35°C) and document areal extent and persistence of fog and water vapour sources.

OBJECTIVES:

The objectives of this project were: to observe and document occurrences of low temperature fog in the Mildred Lake area; to determine chemical composition of low temperature fog; and to relate fog occurrence to meteorological conditions.

STATUS:

Observations of low temperature fog were made on several occasions in December 1977 and January 1978. Occurrences were documented photographically and fog fallout samples were collected for chemical analysis in some cases. The work for this project was conducted in conjunction with ME 1.1, 1.2, 1.3, and 1.4.

The evaluation of conditions under which low temperature fog forms will be undertaken in June 1978.

REPORT:

The results of this project will be included in a report to be completed in the summer of 1978.

ME 3.8.3
Calculate Sigma Data for the AOSERP Study Area

RESEARCHER: Dr. D.S. Davison

AFFILIATION: INTERA Environmental Consultants Ltd.

DESCRIPTION:

This project was designed to bring together all relevant data collected in the AOSERP study area that can be used to calculate dispersion coefficients.

OBJECTIVES:

The objectives of this project were: to examine all sets of turbulence and diffusion measurements made in the study area and calculate sigma values where sufficient data exist; and to recommend alternative programs of measurement that will enable the calculation of sigma data with a higher level of precision.

STATUS:

This project started in January 1978; the organization of most of the data was complete by the end of February.

Subsequently, work has progressed on analysis of the data and evaluating areas where data are deficient.

REPORT:

The final report on the study is due in August 1978.

ME 4.2.2
Air Quality Simulation Modelling

RESEARCHERS: Dr. J. Padro and D. Bagg

AFFILIATION: Atmospheric Environment Service, Downsview

DESCRIPTION:

This project was intended to provide the initial stages of applying air quality simulation models to the AOSERP study area.

OBJECTIVES:

The objectives of this project were: to adapt the CRSTER model for application in the AOSERP study area; to prepare representative data sets and to process data from the study area; to achieve successful computer runs with artificial and real data to calculate ground level concentrations; and to transfer the LIRAQ from Lawrence Livermore Laboratories to AES for adaption to the AOSERP study area.

STATUS:

The CRSTER has been adapted for application in the study area. Computer runs have been successfuly completed using artificial data and good progress has been made in preparing representative data sets. However, thus far, sufficient data have not been available to permit the seasonal calculations of ground level concentrations of sulphur dioxide.

The LIRAQ model has been studied and arrangements are being made to have it transferred from the Lawrence Livermore Laboratories to AES computer facilities at Downsview.

The work is planned to continue through 1978-79.

REPORT:

The interim report for this project has been received and is in review.

HUMAN SYSTEM
RESEARCH ACTIVITIES, 1977-78

Research in the Human System is oriented towards establishing baseline states for demographic patterns and social conditions in the AOSERP study area and determining what changes may occur in these as a result of oil sands development. A major objective of the research will be to identify the means of minimizing the effects of undesirable social changes and maximizing the beneficial effects. Research in human ecology will also be aimed at providing an understanding of the relationship between people and their environments, including both the urban and natural environments in the study area, and the resources for human use in those environments.

Research in the Human System will continue along three main lines (core activities): (1) defining baseline states of the human environment in an historical and regional context; (2) identifying and monitoring the impact over time of oil sands development upon the human environment; and (3) studying the relationship between people in the study area and the changing urban and natural environments.

The Human System research program has been conceptually divided into five sectors:

1. Historical Background: to provide the general context in which contemporary and future patterns of impacts associated with the oil sands development will be interpreted.
2. Economic Overview: to assess the evolution of the local economy since 1961, develop techniques for observing and monitoring future economic evolution, and explore the relationship between economic developments and the social and personal stresses identified in other research sectors.

3. Social Impact Studies: to identify and explain the relationships between changing social conditions and the adjustment processes of people at different stages of resource development activities, in order to provide a data base and information that will help the interested agencies to maximize the positive effects and to minimize the negative effects of oil sands development on people in the region.
4. Labour Related Problems: to analyze the extent, nature, and significance of these problems in relation to minimizing their possible negative effects on the development of local communities and on the local employers.
5. People and Their Environments: to identify the effects of increasing population in the region on recreational and consumptive use of the natural resources, and the effects of changes in the natural and man-made environments on people in the region.

Research activities during 1977-78 focussed on defining the baseline states in an historical and regional context, and on preparing a research design for identification of social impacts associated with the oil sands development. To that effect three new research projects were implemented:

1. Oral History program, which is to add to existing data in the primary and secondary sources by recording oral historical information from the indigenous people in the oil sands region, and which is to be followed by research on the Socio-Economic History of the oil sands region from 1890 to 1960.
2. Research Design for a Longitudinal Study of Social Characteristics and Personal Adjustment in the Fort McMurray Area, which is to use several types of data gathering methods to measure changes in social problems over a period of time covering both a relatively

stable phase of oil sands plant operation and a phase of new plant and town construction.

3. A Study of Native Employment Patterns in the Athabasca Oil Sands Region, which is to analyze the adjustment of native people to the predominantly industrial work world of oil sands communities.

The above research projects represent a major step towards systematic assessment of the impacts of oil sands development upon the quality of life in the AOSERP study area.

B. Kasinska-Banas
Research Manager
Human System

Human System Projects

HE 2.2.2
Community Studies: Fort McMurray, Anzac, Fort MacKay

RESEARCHERS: E.W. Van Dyke and C. Loberg

AFFILIATION: Applied Research Associates

DESCRIPTION:

The community studies were to identify areas of social and personal concern to residents of Fort McMurray, Anzac, and Fort MacKay at the time of oil sands plant and town construction. The principal methods of data collection included participant-observer techniques, and directed and non-directed interviews with residents in the Athabasca Oil Sands region.

OBJECTIVES:

The objectives of this project were to provide an insight into the relationship between social and personal problems experienced or perceived by residents in the region and the oil sands development activities, and to provide information which would help to develop pertinent research questions for a long-term scientifically rigorous study of social impacts associated with the oil sands development.

STATUS:

Work in this project began in September 1976, and was completed in May 1977.

As part of the project, the draft report was made available in March 1978 to various agencies and significant individuals in the region. Their comments are included in a separate chapter of the final report.

REPORT:

The final report, which was received in May 1977, is to be published in 1978; it is currently in review.

HE 2.5
Oral History of the Athabasca Oil Sands Region

RESEARCHER: J.M. Parker

AFFILIATION: Boreal Institute, University of Alberta

DESCRIPTION:

To place the current social impacts associated with oil sands development in an historical context, a Research Design was developed for the study of history of the Athabasca Oil Sands region from 1890 to 1967. The proposed historical research included traditional methods and an oral history program. The oral history program was to add to existing data in the primary and secondary sources by obtaining oral historical information from indigenous people in the oil sands communities.

OBJECTIVE:

The objective of this project was to record, analyze, and interpret the oral historical recollections and memories of elders and indigenous persons in the oil sands region, focussing on population migrations, economic history, human ecology, and the relationship between society and various levels of government.

STATUS:

The project began on 1 October 1977. As part of the project, native interviewers were trained at a seminar held on 7 November 1977, at the AOSERP Mildred Lake Research Facility. The interviewing of native elders and of native and non-native indigenous persons in the oil sands region is in progress, and is planned to be completed by 31 July 1978.

REPORT:

An interim report is due 31 July 1978, and a final report is due 31 October 1978.

HE 3.1
Longitudinal Study of Social Characteristics and Personal Adjustment in the Athabasca Oil Sands Region

RESEARCHER: Dr. E. Berger

AFFILIATION: Earl Berger Ltd., Edmonton

DESCRIPTION:

The project was to identify and explain the relationships between social and personal adjustment of people in the Athabasca Oil Sands region and the different stages of resource development activities, in order to provide a data base and timely information that will help the interested agencies to maximize the positive effects and to minimize the negative effects of oil sands development on people of the region.

OBJECTIVES:

The objectives of this project were:

1. To identify, analyze, and explain changes in social conditions in the region since 1961, in relation to various phases of oil sands development;
2. To identify, analyze, and explain the specific social and personal problems faced by people in their efforts to adjust to life in the region;
3. To identify and explain the relationships that exist between social conditions and the adjustment processes of people at different stages of oil sands development; and
4. To identify areas of concern which may arise out of the research and suggest practical means of meeting these concerns.

STATUS:

This project is divided into three phases extending over a period of four fiscal years, from 1977 to 1981. Phase I of the project, including the Research Design, is to be completed by 31 July 1978. Phase II is to include first field measurements undertaken in September to October 1978 and data analysis, and is to be completed by 30 June 1979. Phase III of the project, including second field measurements undertaken in the fall of 1980 and data analysis, must be completed by 31 March 1981.

REPORT:

Interim reports are due 31 July 1978 and 30 June 1979; the final report is due in draft form on 27 February 1981, and in camera-ready form on 31 March 1981.

HE 4.1
Native Employment Patterns in the Athabasca Oil Sands Region

RESEARCHER: Dr. Marvin Nygaard

AFFILIATION: Canadian Institute for Research in the Behavioral and Social Sciences, Calgary

DESCRIPTION:

The term "native employment patterns" includes employment, under-employment, and unemployment among Treaty Indians, non-Treaty Indians, and Metis people residing and/or working in the Athabasca Oil Sands region. This project was to assess all employment patterns of native people in the region, with emphasis on native workers in the major industries, in order to provide information that will help to develop measures facilitating successful adjustment of native people to life in the predominantly industrial environment of the future.

OBJECTIVES:

The objectives of this project were:

1. To assess all employment, under-employment, and unemployment patterns of indigenous, migrant, and in-migrant native workers;
2. To assess the effectiveness of training-employment programs implemented in the region to facilitate the adjustment of native people to work in major industries; and
3. To identify means which would help native people to successfully adjust to life in the industrial environment or resource communities.

STATUS:

The project is divided into two phases. Phase I of the project, including assessment and analyses of the existing data, and a design for Phase II, is to be completed by 31 August 1978. Phase II of the project will be contingent upon research results of Phase I, and is to be completed by 31 December 1978.

REPORT:

An interim report is due 31 July 1978; a final report is due in draft form on 30 November 1978 and in camera-ready form on 31 December 1978.

LAND SYSTEM

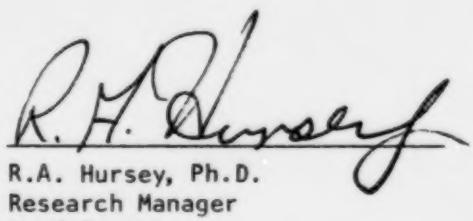
RESEARCH ACTIVITIES, 1977-78

Land System research is designed to describe baseline states of terrestrial ecosystems of the AOSERP study area and to quantify, predict, and verify physical, chemical, and biological changes in those ecosystems resulting from oil sands development. Objectives of Land System research are to identify reclamation methods that may be useful in restoring biological productivity to disturbed areas, to identify other areas that may be enhanced by mitigation measures, and to develop methods for biomonitoring and protecting ecosystems in those portions of the AOSERP study area not directly affected by oil sands development.

Research in the Land System in 1977-78 included the studies of Vegetation, Wildlife, Soils, and Land Use. The general strategy has been to describe baseline states of terrestrial ecosystems in the study area with a view towards intensifying applied research efforts in years four and five of the Program. Baseline studies have included investigations of vegetation, soils, surfical geology, terrestrial biological studies on a regional basis, and intensive studies on sensitive and/or rare and endangered species on a site-specific basis. Research has been carried out on suitable plant species for oil sands reclamation activities, the possible effects of SO_2 on plants under field and laboratory conditions, and the reinstatement of microbiological activity in disturbed or reconstituted soils.

Core activities in the Land System have been defined as: "baseline states"; "applied research--disturbed areas"; "applied research--undisturbed areas"; and "reclamation". Apart from continuing studies to define baseline states of the study area in 1977-78, research has been re-directed toward years four and five of the Program to assess the effects of oil sands development activities on disturbed and undisturbed portions of the study area and effects on areas which have been rehabilitated after disturbance.

In addition to the continuation of the basic direction of the Program as established in the first two years, most of the effort in the 1977-78 year has been devoted to re-defining the goals of the individual projects, initiation of projects which had been identified but not started, and dealing with the complex problems associated with the reorganization and integration of the former Vegetation, Terrestrial Fauna, and Land Use Technical Research Committees into the Land System.



R.A. Hursey, Ph.D.
Research Manager
Land System

Land System Projects

VE 2.1
Soils Inventory of the Oil Sands Area

RESEARCHERS: Dr. L.W. Turchenek and J.D. Lindsay

AFFILIATION: Alberta Research Council, Soils Division

DESCRIPTION:

Information on the nature, extent, and location of the soils in the Athabasca Oil Sands area will aid in identifying the nature of the interaction between the abiotic and biotic environment, predicting the effects of the oil sands development on the environment, and identifying materials that may be useful in overall development of the area. It was for these reasons that this project was initiated in 1976.

OBJECTIVES:

The objective of this project is to provide baseline data on the soils of the AOSERP study area. The 1977-78 objectives were:

1. To provide soils maps of the identified high priority study area at a scale of 1:50,000;
2. To provide land systems maps, with an attendant key, of the study area at a scale of 1:250,000; and
3. To provide Program Management with copies of field working maps as they are completed.

STATUS:

This project relates well to the AOSERP objective of identifying the nature of interactions among the various components of the environment and those of proposed development and reclamation; it fulfils the Land System objective of establishing baseline states.

The soils of the study area are being mapped using the biophysical approach to land classification in which emphasis is placed on the classification and mapping of certain patterns of soil, landforms, and vegetation. The area mapped to date extends from Township 100 Range 12 east to the AOSERP study area boundary (Range 6) and south to Township 88. Land system maps have been prepared for 1:50,000 NTS Sheets 74D/11, 12, 13, 14, 74E/3, 4, 5, 6, 12, and 13. Others are in preparation. The dominant upland soils of the area are Gray Luvisols and Eutric Brunisols, characterized by white spruce, trembling aspen, and jack pine. Soils developed on materials of recent deposition are Regosols and

Gleysols, while low-lying, poorly drained areas are mainly organic. These soils, a combination of bog and fen peats, occupy a considerable portion of the study area but are relatively thin (<1 m thick). The vegetation on bog soils is dominantly black spruce; sedges dominate on the fens. The inventory will continue in 1978-79.

REPORT:

An interim report has been received that outlines classification and mapping conventions, descriptions of ecological units, soil-drainage-vegetation relationships, area mapped to date, and soil description and analysis. This report has been distributed.

VE 2.3.1
Phase I: Habitat Mapping of the Alberta Oil Sands Environmental Research Program Study Area

RESEARCHERS: M.D. Thompson, M.C. Wride, and M.E. Kirby

AFFILIATION: INTERA Environmental Consultants Ltd.

DESCRIPTION:

The intent of this project was to prepare baseline working maps showing geomorphological and habitat information at a scale of 1:50,000. This represents a static descriptive approach to vegetational distribution, as baseline information, in the study area. The project was initiated in 1977.

OBJECTIVE:

The general objective of the project was to obtain preliminary ecological working maps, at a scale of 1:50,000, of the AOSERP study area showing major landforms, surficial geology, vegetation types, and aquatic habitat types based on interpretation of remotely sensed data with ground truthing. The maps can be used as base maps for more detailed habitat mapping where more detail is required. A secondary objective was to develop mapping correlations between habitat characteristics and remote sensing imagery of the study area.

STATUS:

This project relates well to the Land System objective of undertaking studies which may be used to establish the baseline states for physical, chemical, and biological constituents of the terrestrial ecosystem that could be altered by oil sands development.

During 1977 the entire AOSERP study area was flown to obtain reconnaissance level photographs for mapping and multiband coverage and thermal imagery for co-ordinated studies. In addition, large scale photography and thermal imagery were obtained along seven transects in selected locations.

A classification system was devised for mapping vegetation and surficial geology from 1:60,000 false colour infrared photos. Base maps, vegetation, and surficial geology overlays were created based on the standard 1:50,000 NTS sheets. At present, the east-central portion of the study area has been mapped.

An evaluation of multispectral and multistage remote sensing techniques revealed that false colour infrared photos with a scale of 1:60,000 were useful for mapping most important parameters and were also more economical than larger scales.

As a result of logistical problems, this project will continue in 1978-79 to complete mapping and ground-truthing.

REPORT:

A camera-ready interim report has been received that outlines map preparation, terrain analysis, multispectral and multistage remote sensing evaluation, and includes sections on ecological monitoring and automated ecological mapping; this report has been distributed.

VE 3.1
Symptomology and Threshold Levels of Air Pollutant Injury to Vegetation

RESEARCHER: Dr. S.S. Malhotra

AFFILIATION: Canadian Forestry Service

DESCRIPTION:

Potential adverse effects may result from pollutants (SO_2, nitrogen, oxides, ozone, and vanadium) which are released into the atmosphere in conjunction with oil sands development. Projects VE 3.1, 3.3, and 3.4 were initiated in 1975 to supplement diagnostic, sensitivity, and tolerance information to detect and appraise the impact of these pollutants and prescribe treatments if required.

OBJECTIVE:

The general objective of this project was to develop operational techniques for detecting or diagnosing the impact of

pollutant fumigations upon vegetation prior to the appearance of visual symptoms. The major components of this project were to identify potentially resistant native species, determine the visual and pre-visual symptoms of effluent damage on native species, and develop a simple field test for pre-visual and visual effluent damage.

STATUS:

This project directly addresses two Land System objectives: (1) to assess and report on all physical, chemical, and biological disruptions of the terrestrial ecosystems in the study area resulting from oil sands development, and (2) identify substances which may be introduced into the metabolic pathways of the terrestrial ecosystems and their effects on these metabolic pathways.

Project VE 3.1 relied upon and yielded direction to project VE 3.4, which was the field monitoring component of the pollutant studies. In 1977-78, research for this project proceeded with ranking of species in the order of their sensitivity to air pollutants (initially, SO_2; future studies will look at other pollutants and combinations); this ranking is requisite for interpreting air pollutant injury to vegetation and changes in species composition in the field. Six boreal forest plant species were fumigated for up to 40 days at 0.34 ppm SO_2. All species showed a gradual decline in CO_2 gas exchange that was related to symptom development characteristics of SO_2 toxicity. Paper birch was the most sensitive species to SO_2 injury, followed by green alder, jack pine, labrador tea, and white and black spruce.

REPORT:

A draft interim report on this project has been received and is in review.

VE 3.3
Physiology and Mechanisms of Air-borne Pollutant Injury

RESEARCHER: Dr. S.S. Malhotra

AFFILIATION: Canadian Forestry Service

DESCRIPTION:

Potential adverse effects may result from pollutants (SO_2, nitrogen, oxides, ozone, and vanadium) which are released into the

atmosphere in conjunction with oil sands development. Projects VE 3.1, 3.3, and 3.4 were initiated in 1975 to supplement diagnostic, sensitivity, and tolerance information to detect and appraise the impact of these pollutants and prescribe treatment if required.

OBJECTIVE:

The general objective of this project was to determine the tolerance of selected native vegetation in the Athabasca Oil Sands area to SO_2 and other pollutant fumigations and to identify species that can be used as representative indicators of the general air quality in the region. Co-operation with VE 3.1 was necessary to develop a simple field test for pre-visual and visual effluent damage as well as to compare physiological response to effluents of resistant and susceptible native species, evaluate resistance in the context of probable climatic stresses, and investigate the physiological and biochemical pathways as an aid to determining impact symptoms of effluents other than SO_2.

STATUS:

This report is applied research that addresses the Land System objectives of assessing disruptions of the terrestrial ecosystem from oil sands development and identifying substances introduced into the metabolic pathways of these systems and their effects on the metabolic pathways. It also relates to the Program objectives of identifying the nature of interactions among components of the environment and those associated with development as well as researching effects on and resiliency of environmental systems that may be affected by oil sands development.

Once visual symptoms develop, vegetation injury may be irreversible. To develop a simple field test for pre-visual symptoms of effluent damage, this study first concentrated on the biochemical and cellular physiological response of candidate revegetation species to SO_2. Thus, research in 1977 continued on biochemical studies under controlled conditions. Preliminary results suggest that low concentrations of SO_2 (which normally do not produce any visual symptoms on foliage) cause injury to forest vegetation by altering pigment metabolism, inhibiting lipid synthesis and activities of various important enzyme systems, and by causing ultra-structural disorganization of cellular membranes. Results to date indicate that chlorophyll/phaeophytin ratio, Mg^{++} content, lipid biosynthesis, and acid phosphatase and malate dehydrogenase activities are very sensitive indicators of SO_2 concentrations.

REPORT:

An interim report outlining 1977 research has been received, and is in review.

VE 3.4
Ecological Benchmarking and Biomonitoring for Detection of Air-borne Pollutant Effects on Vegetation and Soils

RESEARCHERS: Dr. P.A. Addison and J. Baker

AFFILIATION: Canadian Forest Service

DESCRIPTION:

Potential adverse effects may result from pollutants (SO_2, nitrogen, oxides, ozone, and vanadium) which are released into the atmosphere in conjunction with oil sands development. Projects VE 3.1, 3.3, and 3.4 were initiated in 1975 to supplement diagnostic, sensitivity, and tolerance information to detect and appraise the impact of these pollutants and prescribe treatment if required.

OBJECTIVE:

The general objective of this project was the establishment and inventory of selected plots as representatives of the vegetation and soil before the initiation of oil sands development. This entailed examining impact of effluents on the native vegetation at the plant community level in order to identify necessary successional studies.

STATUS:

This project fulfils the Land System objectives of assessing and reporting on disruptions from oil sands development to the terrestrial ecosystems and identifying substances which may be introduced into the metabolic pathways of the terrestrial ecosystems and their effects on these metabolic pathways. The project also relates to the Program Management objectives of identifying interactions among the components of the environment and those related to development activities as well as researching effects on and resiliency of the environmental systems.

To date, 11 sites have been established in the AOSERP study area to provide baseline information on vegetation and soils with respect to air pollution impact. These sites, which were located for use in long-term biomonitoring, were described with respect to their vascular and cryptogamic species list, stand density and age, soil characteristics and type, and cover and frequency of lower strata species. No apparent impact was detectable that could be attributed to air pollution during the course of the study. Additional temporary sites were established for use in the development of biomonitoring techniques; several of these techniques were sensitive enough to detect the subtle effects of pollutants.

Research in 1978-79 in this project will entail extensive co-operation with a new project, LS 11.1, to establish the long-term biomonitoring plots in the AOSERP study area.

REPORT:

A draft interim report that describes the sites and biomonitoring results to date has been received; this report is in review.

VE 4.1
Soils Research Related to Revegetation of the Oil Sands Area

RESEARCHER: Dr. W.B. McGill

AFFILIATION: University of Alberta, Department of Soil Science

DESCRIPTION:

This project was initiated in 1975 to obtain basic soil data on disturbed and undisturbed sites in the Athabasca Oil Sands area; these data can be used in developing sound management programs to ensure successful revegetation of spoil piles, tailings sand piles, etc., and to develop ways of improving soil factors.

OBJECTIVES:

The specific objectives of this project were to:

1. Examine the probability of success of clay lenses to develop perched water tables in tailing sands;
2. Examine the chemical, physical, and microbiological properties of tailings sand and overburden, alone, in various combinations, and with peat amendments;
3. Examine control areas to determine the baseline states of these soil characteristics; and
4. Examine nutrient cycling in fertilized and unfertilized soils as outlined in 2 above.

STATUS:

This project relates to the Land System objectives of describing baseline states of terrestrial ecosystems in the AOSERP study area and quantifying, predicting, and verifying physical, chemical, and biological changes in these ecosystems resulting from oil sands development. It also addresses the ultimate Land System objective of identifying reclamation methods which will be useful in restoring productivity to disrupted areas.

Eleven field sites have been established (1976) and instrumented to improve understanding of the relationship between the soil physical conditions and vegetation. Emphasis in 1977 was placed on gathering detailed information on moisture tensions. Preliminary results indicate that excessively large moisture tensions did not occur in natural soils; however, on the GCOS dike large tensions occurred in late May, and by late August occurred throughout most of the rooting zone.

Field nutrient cycling studies were continued at several forest sites.

Examination of grass legume growth revealed that tailings sand alone produced little growth while peat and peat-till surface mixes produced the best growth in the field lysimeters.

The study on the effect of a buried till layer on water storage in layers above it requires further monitoring.

REPORT:

A draft interim report has been received that outlines the field studies, indoor and field lysimeters and plots, and laboratory studies; this report is in review.

VE 4.2
The Rate and Extent of Soil Changes Induced by Sulphur in the Oil Sands Area

RESEARCHERS: Dr. M. Nyborg, P.W. Parker, and P. Yeung

AFFILIATION: University of Alberta, Department of Soil Science

DESCRIPTION:

This project was initiated with VE 4.1 in 1975 to undertake soils research related to revegetation of the oil sands area. Unlike VE 4.1, which dealt with soil physics, this project was designed to study the impact of SO_2 on soils.

OBJECTIVES:

The project was designed to:

1. Determine the mechanism and rate of SO_2 uptake by soils;
2. Find the effect that this has on soil pH, available sulphur, and biological activity;
3. Determine the extent of SO_2 damage to soils; and
4. Study countermeasures against this damage.

STATUS:

This project addresses the Program Management objectives of determining the nature and magnitude of change in environmental systems that can be expected to result from oil sands development and of identifying the nature of interactions among components of the environment and those of proposed development activities.

Monitoring of a network of 16 field stations established in 1976 and stratified in four zones in relation to emission source continued in 1977. Sulphation discs and rain gauges were placed at each station to sample dry deposition and precipitation. Sulphur uptake was monitored at each station for pots of several soil types, principally bare soils and lichen-covered soils, and two species of moss. Leachate was collected from lysimeters at nine stations to determine the rate of movement of sulphur and cations through soil profiles. Work continued at the two sites established for an intercepted rain study in 1976.

Four new sites were established to study the influence of SO_2 emissions on the chemical composition of jack pine stemflow, and three new locations were established to determine the downward movement of sulphate sulphur through soils. Results to date indicate that, although the sulphur content of rain is low, there is a gradient of decreasing SO_4-S in rain with increasing distance from the emission source. Sulphur deposited in throughfall and stemflow was twice that in rain at sites close to the emission source.

REPORT:

The 1977-78 interim report includes preliminary results of this study. A draft of this report has been received, and is in review.

VE 5.2
Characterization and Utilization of Peat in the Oil Sands Area

RESEARCHERS: J.D. Lindsay, K. Kong, and W.B. McGill

AFFILIATION: Research Council of Alberta, Soils Division

DESCRIPTION:

Peat is the only organic material naturally available for rebuilding soil fertility after mining. This project was initiated in 1975 to study the characteristics of peat (before, during, and after storage) in the oil sands area with a view of establishing handling methods that ensure optimum quality of peat for use in reclamation.

OBJECTIVES:

The general objectives of this study were: to characterize the peat as it is stripped and stored in the mining process and compare the properties of the stripped peat to stored pure peat at the Evansburg site as baseline data; and to compare pure peat to stripped peat as a soil amendment material and develop guidelines for the best handling of peat to be used as a reclamation material.

STATUS:

The project addresses the Program Management objective of identifying baseline states and the nature and extent of interactions among components of the environment and those of proposed reclamation activies (stored peat).

Research in 1977 on stored peat continued at the two study sites established in 1976 at Evansburg, Alberta and Mildred Lake. In addition, sampling, monitoring, and field studies were conducted in adjacent peatlands. Physical, chemical, and microbiological properties of fibric and mesic peat and fen samples were determined. The effects of drying, freezing/thawing, and fertilizer additions to fibric, mesic, and fen peats were investigated to assess the rate of decomposition in stored peat.

Stored material at Evansburg was essentially pure peat while that at Mildred Lake was a mixture of peat and inorganic material. The Mildred Lake samples exhibited greater microbiological activity which may be attributed to the inorganic constituents and to the application of commercial fertilizer. Unlike the stored peat, undisturbed peat near Mildred Lake showed little activity. Unfortunately, the peat piles at the Mildred Lake site were destroyed, and new storage piles must be established in 1978-79.

REPORT:

The interim report, of which a draft is in review, outlines results to date on baseline studies of peat and studies of the storage piles.

VE 6.1
Long Term Prediction of Vegetation Performance for Dike Management

RESEARCHERS: Dr. L.C. Bliss and Dr. D.W. Whitfield

AFFILIATION: University of Alberta, Department of Botany

DESCRIPTION:

This project was designed to develop and evaluate potential management strategies for long-term maintenance of vegetation of steep-sided dikes created by mining operation, using ecophysiological methods that incorporate mathematical modelling through regression analysis.

OBJECTIVE:

The study was to characterize the behaviour of the vegetation on a stable land slope dominated by jack pine. The major controlling parameter was assumed to be water and, to a lesser extent, nutrients. By modelling the dynamics of biological responses of a stable community on sand, it was believed that a prediction would be possible of the development and stability of a potential end point of plant succession following abandonment of sand piles and associated dike systems in the extraction areas.

STATUS:

This research was initiated in the 1975-76 fiscal year, continued in 1976-77 and was to be completed in the 1977-78 year.

REPORT:

The final report (due 1 January 1978) incorporating the three years of research has not yet been submitted.

VE 7.1
Reclamation Afforestation by Suitable Native and Introduced Tree and Shrub Species

RESEARCHERS: Dr. S.K. Takyi, G. Dunsworth, and J. Sherstabetoff

AFFILIATION: Energy and Natural Resources, Alberta Forest Service

DESCRIPTION:

This project was designed to evaluate the suitability of native and introduced trees and shrubs as reclamation materials for disturbed areas within the AOSERP study area.

OBJECTIVES:

The objectives of this project were:

1. To conduct field research on native and naturalized exotic woody species for survival and growth on pure and amended tailings and spoil materials;

2. To determine causes of mortality and develop mitigation procedures in conjunction with other projects;
3. To test ecotypes from invading populations of other disturbed sites for performance on disturbed soils resulting from oil sands mining;
4. To develop recommendations of genotypes which should be placed in nursery production for large-scale afforestation trials; and
5. To make recommendations for afforestation planting trials.

STATUS:

This project was first initiated in 1974 by the Alberta Forest Service; AOSERP support began in 1975 and has continued to the present. The study sites are located on the dike and overburden material on the GCOS lease. In the 1977-78 fiscal year, considerable redirection of objectives and methodology was undertaken to reorient the project to AOSERP objectives. This redirection is exemplified by the replacement of the demonstrations by formal field trials.

Effort in 1977-78 concentrated on: the design of these formal field trials emphasizing native species; extensive collections of seeds of native trees and shrubs; a literature review of the subject; and the preparation of a comprehensive report on the project to date. Data were also collected on seedling survival and performance (vigour and growth) and on the general adaptability of the trees and shrubs to the waste materials.

REPORT:

A draft interim report has been received, and is in review.

VE 7.1.1
Control of Small Mammals on Reclamation Areas in the AOSERP Study Area--Literature Review and Problem Analysis

RESEARCHERS: Dr. A. Birdsall and J. Green

AFFILIATION: LGL Ltd., Environmental Research Associates

DESCRIPTION:

Large tracts of land are being and will be disturbed during the operation of open pit mines and oil extraction plants in the Athabasca Oil Sands area. These areas will require an extensive reclamation/revegetation program and rodent damage to revegetation areas has the potential to be a major problem. This project

was initiated in 1977 and is a continuation of previous research in 1976 on the control of small mammals in reclamation areas.

OBJECTIVES:

The objectives of this project were to review the literature on small mammal damage to revegetation areas and on small mammal control procedures, to define the extent and severity of small mammal damage to revegetation research plots, and, on the assumption that there will be a problem, to plan research to develop an ecologically and economically acceptable small mammal control program.

STATUS:

This project related to the Land System objectives of reviewing and assessing available information pertaining to terrestrial ecosystems of the area; assessing and reporting on biological disruptions in the study area resulting from oil sands development; and undertaking studies to restore biological productivity to disrupted terrestrial ecosystems. It also addresses the Program Management objectives of identifying interactions among components of the environment and those of development and reclamation activities.

Research in 1977 concentrated on reviewing pertinent literature, making recommendations based on the results of the literature review as to the best method of small mammal control, and proposing a research program to evaluate the effectiveness of recommended controls.

Because of untimely lease access, field research on defining the small mammal problem was limited to the establishment of two woodland study sites where trapping grids were established. Results of the literature review indicate that methods for the most promising program of small mammal damage control include the provision of supplementary food, manipulation of habitat by the reduction of cover, the use of chemical repellants, or a combination of these methods.

Field research results indicated that Clethrionomys gapperi and Tamiasciurus hudsonicus were the most abundant small mammal species on the plots. Of 1,000 saplings examined for small mammal damage at each area, only 11 trees showed indications of damage. Data were collected on species composition and density of ground cover and saplings.

REPORT:

A draft interim report that outlines the 1977-78 research has been received and is in review.

VE 7.2, 7.3, and 7.4
VE 7.2 Controlled Environmental Tests of Species Suitable for Revegetation
VE 7.3 Field Trials to Test Plant Communities
VE 7.4 Technology of Seed Production and Handling

RESEARCHER: Dr. H. Vaartnou

AFFILIATION: Vaartnou and Sons Enterprises Ltd.

DESCRIPTION:

These projects were designed to identify native herbaceous and shrubby species suitable for oil sands reclamation work and to investigate methods for the establishment of these species on disturbed soils.

OBJECTIVES:

The objectives for the 1977-78 research were:

1. To identify and collect propagules from herbaceous and shrubby species with high potential for use in the oil sands reclamation;
2. To test these species for survival and establishment on disturbed soil, tailings sand, amended tailings sand, and spoil materials;
3. To develop techniques to provide supplies of proven genotypes for use in large-scale reclamation projects; and
4. To develop techniques for establishment of proven genotypes on disturbed areas in the AOSERP study area.

STATUS:

These projects developed from a program initiated in 1973 by Alberta Agriculture, Alberta Environment, and Alberta Highways. AOSERP began support in the 1975-76 fiscal year. The 1977-78 fiscal year concludes the involvement of the present contractor.

In 1977-78, a literature review on the use of native species in revegetation was compiled. A greenhouse study was conducted to investigate native grasses and legumes on lightly amended tailings and sand mixtures. Collection nurseries were established at Vegreville Environmental Laboratory site and at the AOSERP Mildred Lake Research Facility. A soil amendment-plant community was established on GCOS waste dump No. 5, and a plant community study was also established on GCOS waste dump No. 5. Twelve species of grasses planted in 1975 on the GCOS dike were evaluated for survival and vigour. Seed production was evaluated at Ellerslie, High Level, Vegreville, Peers, and Waskatenau.

REPORT:

The draft final report has been received and is in review.

VE 9.1
Reinstatement of Biological Activity in Disturbed Soils and Mine Wastes

RESEARCHERS: Dr. D. Parkinson, Dr. B. Danielson, S. Visser, and J. Zak

AFFILIATION: Research Secretariat, Alberta Department of Environment

DESCRIPTION:

A stabilized terrestrial ecosystem is developed on a soil with a healthy soil microbiological population in balance with available nutrients. This study, by supporting and expanding on existing research on mine tailings, is expected to develop the understanding necessary to achieve a self-sustaining microbiological population in soils and tailings materials in the AOSERP study area. AOSERP is contributing to the project which is under the auspices of the Research Secretariat.

OBJECTIVES:

The 1977-78 objectives are summarized below:

1. To establish sample sites in the AOSERP study area and sample plots in validation tanks at Spy Hill, University of Calgary;
2. To establish, monitor, and evaluate various experiments in the validation tanks including decomposition rates of standard substances; development of root region microflora; chemical, physical, and biological characteristics of soils; and to develop pot experiments and test plants; and
3. Institute studies to identify and quantify microbiological populations from AOSERP study sites and initiate decomposition studies.

STATUS:

This project relates well to the Land System objectives of identifying baseline states and undertaking studies toward restoration of biological productivity to terrestrial ecosystems affected by oil sands development. This research will also help identify reclamation methods that will be useful in restoring productivity to disrupted areas.

Research in 1977 consisted of preliminary sampling of soil at an undisturbed jack pine location, sampling of natural materials for subsequent decomposition studies, and sampling of fungus and living plant materials for mycorrhizal investigations. Some preliminary results on the spoils sampling, effects of amendments on mine spoils, germination of test plant species on spoil, microclimatic measurements, plant establishment and growth on spoil with amendments, fungal and bacterial populations, total microbial

biomass, soil characteristics, organic matter decomposition, and nitrogen fixation are included in an interim report. Similar data on spoil from Bow City and Luscar sites are included in this report to the Research Secretariat.

REPORT:

A copy of the report submitted to the Research Secretariat has been received and is in review.

TF 1.1
Moose, Caribou, Wolf Ecology

RESEARCHERS: Dr. L. Keith, T. Hauge, R. Rolley, T. Fuller, and W. Mytton

AFFILIATION: University of Wisconsin; Alberta Recreation, Parks and Wildlife, Fish and Wildlife Division; Alberta Research Council

DESCRIPTION:

This project, which was initiated in 1976, was a combination of research begun in 1975 designed to gain a thorough understanding of the existing status of moose, wolf, and caribou in order to identify baseline states for these species.

OBJECTIVES:

The objectives of this project were to describe and quantify the baseline states of moose, wolf, and caribou in the Athabasca Oil Sands area, with special emphasis on critical areas and winter ranges; to describe and quantify moose/wolf interactions, with special reference to population regulation within wolf packs; and to determine the effects of normal mortality, human exploitation, and carnivore predation on moose and caribou.

STATUS:

This project fulfils the Land System objective of establishing baseline states for constituents of the terrestrial ecosystems of the study area that would be altered by oil sands development. Research that has previously been undertaken on the AOSERP study area (moose, caribou, wolf), at Rochester, Alberta (moose study), and in the Swan Hills (wolf study), is described in the 1976-77 interim report. Research at Rochester and in the AOSERP study area (moose, Muskeg River basin; caribou, Birch Mountain; wolf, Birch Mountains, Muskeg River Basin, and an area near Fort MacKay) continued in 1977-78.

The Rochester moose population is unhunted and free of wolf predation. Current moose densities, calf-cow ratios, and twinning rates in this area are 0.77/km^2, 94:100, and 45%, respectively, and are typical of an increasing population. Seasonal movements indicate that medium to full density uplands were used mainly in the winter, open lowlands and muskeg were used in spring, and a shift to uplands of medium density occurred in the summer. Distances to human disturbance varied seasonally; moose were closest to disturbance in winter and farthest away in summer. In contrast, preliminary results from the moose study in the AOSERP study area indicate a density of 0.32/km^2, with mortality resulting mainly from hunters and wolves (wolves accounted for 65% of adult and yearling mortality).

Wolf studies indicate approximately 150 (0.006/km^2) wolves reside in the AOSERP study area. Steel trapping and early pup deaths are the major mortality factors. Beaver and moose are the main prey items; diet varies seasonally.

Caribou densities in the Birch Mountains are estimated between 0.017/km^2 and 0.044/km^2. Population data to date are indicative of a declining population.

Additional information on sex ratios, distribution, movements, reproduction, mortality, habitat use, etc. of each species is contained in the 1977 interim report. Some additional baseline studies to fill data gaps are continuing.

REPORT:

A draft interim report has been received and is in review. The final report is due in 1979.

TF 1.1.1
Analysis of the 1978 Moose Census Data and Associated Visibility Bias

RESEARCHER: J.O. Jacobson

AFFILIATION: Interdisciplinary Systems Ltd.

DESCRIPTION:

This project was a continuation of research begun in 1976 (TF 7.1.1 and 7.2.1). Unlike the earlier studies, which tested the moose census procedures used, analyzed census results, and were to determine statistically reliable moose population estimates, this project was designed to develop an analysis model which would produce statistically reliable estimates of visibility bias and total population.

OBJECTIVES:

The objectives of this project were: to develop a front-back observer visibility bias model; to document in detail the derivation and analysis procedures associated with the front-back analysis model; and to describe the procedures necessary to obtain reliable moose census data using this analysis model.

STATUS:

Reliable moose census data are needed to accurately determine both present (baseline states) and future numbers, distribution, etc. of moose in order to assess any disruptions to moose resulting from oil sands development. Because data reliability is affected by research design and visibility bias, this project will help fulfil the Land System objectives of establishing baseline states and assessing disruptions of the terrestrial ecosystem.

REPORT:

The final report on this project is in review; it will be of value both in assessing current data and in designing any future censuses.

TF 1.4
Black Bear Ecology

RESEARCHER: Dr. R. Ruff

AFFILIATION: University of Wisconsin; Alberta Recreation, Parks and Wildlife, Fish and Wildlife Division; (Gulf Oil has also supported this project)

DESCRIPTION:

This project was a continuation of AOSERP support (initiated in 1976 under TF 1.3) in a jointly-funded, long-term black bear population regulation study at Cold Lake, Alberta.

OBJECTIVE:

The objective of this study was to determine the responses of black bear to: habitat alterations (land clearing, road construction, and drilling operations); environmental disturbances associated with human occupancy at oil sites; and open pit refuse disposal at an experimental site and existing dumps on the study area.

STATUS:

Black bear research, under the direction of several agencies, has been conducted at Cold Lake since 1968. Thus, large amounts of base data exist for this population; current studies are concentrating on how behavioral and environmental factors influence the abundance and distribution of black bears. AOSERP involvement began in 1976, and it is hoped that much of the information obtained will be applicable to black bear populations on the AOSERP study area. This is applied research which will help identify the nature of interactions between and among the various components of the environment and those of proposed development activities.

REPORT:

An interim report is currently in preparation. AOSERP will receive acknowledgement for its support and a copy of the report that is being submitted to Gulf Oil and the Fish and Wildlife Division, who jointly funded the research.

TF 2.1
Avifauna Baseline States

RESEARCHERS: B. Munson, E. Hennan, K. Lumbis, and J. Francis

AFFILIATION: Canadian Wildlife Service

DESCRIPTION:

Initiated in 1976, this project was a continuation of research begun in 1975 designed to describe the baseline states of avifauna in the Athabasca Oil Sands area. The 1977-78 fiscal year was the final year for the project, although some additional baseline information may be collected under or in co-ordination with other projects.

OBJECTIVE:

The objective of this project was to describe the baseline states of bird resources in the Athabasca Oil Sands area to provide basic information to assess the potential effect of industrial development on the bird resources and provide guidelines for habitat reclamation.

STATUS:

This project fulfils the Land System objectives of establishing baseline states for constituents of the terrestrial ecosystem of the study area that could be altered by oil sands development. The project was divided into three main areas: (1) upland game birds; (2) waterfowl; and (3) terrestrial birds. Although surveys were conducted throughout the AOSERP study area, the Muskeg River basin was the focal point of baseline studies in 1977. The study consisted of a detailed census, and habitat quantification and evaluation with emphasis on critical areas.

For waterfowl, wet lands are more heavily used by diving than dabbling ducks. Breeding dabblers prefer emergent vegetation edge habitat combined with a shrub habitat next-to-edge, while divers prefer, in order of preference, emergent vegetation/shrub, wet meadow/coniferous forest, emergent vegetation/wet meadow, and emergent vegetation/mixed forest. In fall-staging surveys, 11,000 to 24,000 ducks were observed.

Terrestrial breeding bird studies were combined with intensive habitat quantification, allowing determination of the relative value of 21 habitat types to breeding avifauna.

REPORT:

The draft final report has been received and is in review; it contains an annotated list of bird species observed in the study area, and details suitable and preferred habitats, densities in all habitats, etc. Potential impacts of oil sands development and guidelines for reclamation are also outlined in the report.

TF 2.2
Rare and Sensitive Species--
White Pelicans

RESEARCHERS: R. Beaver, D. Ealey, and M. Ballantyne

AFFILIATION: Canadian Wildlife Service

DESCRIPTION:

This project was initiated in 1976 and was a continuation of White Pelican research begun in 1975 under TF 1.1.2: Endangered Species.

OBJECTIVE:

The general objective of this project was to describe the baseline states of the White Pelican in the Athabasca Oil Sands area to assess the potential effects of industrial development and related activities and to provide guidelines for habitat reclamation. Emphasis in 1977-78 was on the determination of habitat requirements, especially critical areas, the development of preliminary habitat maps, the determination of population structure, distribution, movements, relationships to fish, and impacts of development on White Pelicans, and the development of management alternatives and strategies.

STATUS:

This project fulfils the Land System objectives of determining baseline states. Studies in the 1977-78 fiscal year continued in the Birch Mountains area. The first spring arrival occurred on 22 April. Birch Lake, which was the only occupied rookery, had a population of approximately 140 adults and 55 young (raised during the year). Breeding success was calculated at 35.7%; the fledgling rate was 0.78 young per nest. The home range of pelicans breeding at Birch Lake was calculated as 193,642 ha. Pelicans used foraging/loafing areas up to 69 km from the rookery. Loafing bars appear to be important features of pelican habitat. Other criteria for pelican habitat are listed in the report. Juvenile pelican diet consisted mainly of Brook Stickleback, Northern Pike, and Lake Whitefish. All young and adults had departed from the rookery by mid-October.

REPORT:

A draft interim report has been received which outlines breeding and foraging behavior, biology, and distribution of the White Pelican in the oil sands area. This report is in review.

TF 2.3
Baseline States of Rare and Sensitive Species

RESEARCHERS: D. Ealey and L. Johnston-Beaver

AFFILIATION: Canadian Wildlife Service

DESCRIPTION:

This project was initiated in 1977 but was a continuation of research begun in 1975 under TF 1.1.2 and in 1976 under TF 2.2. The project encompassed three sub-projects:

TF 2.3.1: Peregrine Falcon Population Monitoring
2.3.2: Bald Eagle Foraging Patterns and Characteristics of Foraging Areas
2.3.3: Inventory of Bald Eagles, Osprey, and Colonial Species in the Richardson River Area.

OBJECTIVE:

The general objective of this project was to describe the potential impact of oil sands development on rare and sensitive avian species and to make recommendations on strategies which will enhance these species in the post development period.

STATUS:

This project fulfils the Land System objective of establishing baseline states in order to assess potential impacts related to oil sands development. Research in 1977-78, the third year of inventory, was centred in the Fort Chipewyan (for Peregrine Falcon), Birch Mountains, and Richardson Lake areas. Three major groups of birds were studied: (1) raptors, (2) colonial birds, and (3) sensitive species. Among the raptors, Bald Eagles were most numerous, Osprey and Peregrine Falcons were second most abundant, and Golden Eagles were rarest in abundance. Bald Eagles forage extensively on fish, and locate nest trees less than 50 m from water. Nest trees were generally tall (14 m) and broad; jack pine, spruce, and aspen were used, and live trees were preferred.

Colonies of Bonapartes Gulls, California Gulls, and White Pelicans were observed in the Birch Mountains area.

The common Loon was abundant; however, another sensitive bird, the Sandhill Crane, was rare.

REPORT:

A draft interim report has been received which outlines the preliminary information on numbers, distribution, foraging, breeding biology and phenology, habitat requirements, sensitivity, production, etc., of many of these species and states some potential impacts and recommendations. This report is in review.

TF 3.1
Semi-Aquatic Mammals
(Beaver, Muskrat, Mink, River Otter)

RESEARCHER: Dr. F. Gilbert

AFFILIATION: University of Guelph

DESCRIPTION:

The 1977-78 fiscal year represented the first full field season for research in this project, which was initiated in September 1976.

OBJECTIVE:

The general objective of this project was to determine the role and significance of semi-aquatic mammal populations in the undisturbed and disturbed boreal forest ecosystem in order to predict the potential impact of oil sands development and recommend strategies to enhance these populations in the post development period.

STATUS:

This project relates to the Land System objectives of establishing baseline states and assessing potential disruptions resulting from oil sands development.

During the 1977-78 fiscal year, much of the emphasis in this project was on completion of a detailed annotated bibliography that encompasses life history, physiology, mortality factors, environmental quality, and management for each of the four species. Field research efforts were concentrated in the Muskeg River and Dover-Snipe headwaters drainage areas. Beaver, muskrat, and mink were live trapped and tagged; however, efforts to capture otter were unsuccessful. Preliminary analysis of otter and mink scats revealed a predominance of fish and mammal remains for each species, respectively. Research on beaver cuttings indicated Populus species were cut preferentially ($P < 0.05$). Aerial surveys for beaver lodges were conducted on the two study areas (Muskeg River: 69 active beaver lodges; Dover-Snipe: 31 active beaver lodges), and surveys for both beaver and muskrat were completed on the Syncrude lease (111 active beaver lodges, 45 abandoned beaver lodges, and 81 active muskrat houses). Efforts were also made to map riparian habitat in the Muskeg River drainage.

The 1977-78 year concludes the present contractor's involvement.

REPORT:

An interim report outlining preliminary results of research to date has been received; it is currently undergoing revision by the author.

TF 5.1
Amphibians and Reptiles

RESEARCHERS: Dr. W. Roberts, Dr. V. Lewin, and L. Brusnyk

AFFILIATION: University of Alberta

DESCRIPTION:

The 1977-78 fiscal year was the final year for this project, which was initiated in 1976 to examine the potential impacts of oil sands development on the amphibian and reptile species of the area.

OBJECTIVES:

The objectives of this project were:

1. To describe the habitat types of the amphibian and reptile species in the area and estimate species numbers and distribution as a function of habitat type and size;
2. To document breeding biology and phenology;
3. To identify rare and/or sensitive species and document their status; and
4. To recommend management alternatives and reclamation strategies that will minimize adverse effects of development and enhance amphibians and reptiles in the post development period.

STATUS:

This project fulfils the Land System objectives of establishing baseline states for constituents of the terrestrial ecosystems that could be altered by oil sands development. During the study, three species of amphibians were found in the AOSERP study area; the wood frog (Rana sylvatica) was the most abundant and widespread while boreal chorus frogs (Pseudacris triseriata maculata) and Canadian toads (Bufo hemiophrys) were common. All these species spawned prior to 12 June, favoring natural ponds and borrow pits as spawning sites, and all species had metamorphosed by early August. Population densities of wood frogs, boreal chorus frogs, and Canadian toads reached estimated maxima of 19.6, 2.3, and 12 per 1,000 m^2 during 1977. Maximum densities were found within 50 m of the nearest water body in moist habitat vegetated by sedges, grasses, horsetails, willow, and poplar. No reptiles were found during the study.

REPORT:

A draft final report has been received that outlines habitat, including physio-chemical properties of water, spawning and development, habitat utilization, population estimates, status or other species, and recommendations and implications. This report is in review.

TF 6.2
Impact of Tar Sands Development on the Fur Industry

RESEARCHERS: M. Fox and Dr. W.A. Ross

AFFILIATION: University of Calgary

DESCRIPTION:

Locally, the fur industry in the AOSERP study area contributes substantial economic resources to the community. The establishment of a large, new, wage economy will affect the fur industry. The 1977-78 fiscal year marked the completion of the two year project designed to evaluate the impact of and strategies to minimize the impact of oil sands development on the fur industry.

OBJECTIVES:

The objectives of this project were: to establish baseline information about current trapping practices in the region; to predict the future of trapping from current trapper attitudes; and to propose management considerations that will lessen negative impact of tar sands development on trappers.

STATUS:

This project fulfils the Land System objectives of establishing baseline states and assessing and reporting on disruptions of the terrestrial ecosystems resulting from oil sands development. Work in the 1977-78 fiscal year consisted of analyzing data collected in 1976 and compiling a final report. Data were collected from interviews, trapping surveys, and Fish and Wildlife Division files to ascertain trapper demography, motivations, and trapping patterns in the Fort McMurray area. The study revealed that 70% of registered trappers were Native. Trappers averaged 46 years of age, often held other jobs concurrently, and spent less than two months on the trapline in 1975-76. Trapper effort, trapline distance from the trapper's home, and trapline size had the most significant effects on trapping income.

Trapping incomes in 1975-76 for Fort McMurray, Fort MacKay, and Anzac were calculated at $64,000, $28,000 and $11,625, respectively. Enjoyment of life-style, finanical gain, tradition, and need of meat were the main motivations for trapping.

REPORT:

A draft final report has been received which discusses in detail demography, trapping patterns, motivations, impacts of oil sands development on trapping, and management considerations. This report is currently in review.

TF 6.3
Integration of Remote Sensed and Field Acquired Information

RESEARCHERS: S. Aronoff and Dr. W.A. Ross

AFFILIATION: University of Calgary, Faculty of Environmental Design

DESCRIPTION:

Remote sensing can be used to extend intensive field data from a few sites to a large area, and elucidate distributional patterns and temporal change. Data in the form of remotely sensed imagery can also be used as a base upon which to integrate information. Therefore, because remotely sensed data can be of great value to AOSERP, project TF 6.3 was initiated in 1976.

OBJECTIVES:

The objectives of this study were:

1. To examine the characteristics and advantages of various types of remote sensing imagery for ecological studies within the AOSERP study area;
2. To develop an optimum procedure for the analysis of remotely sensed imagery in conjunction with information generated by ground studies; and
3. To interpret the implication of trapper interactions with oil sands development relative to possibilities of trapper relocation within the AOSERP study area.

STATUS:

This project was related to the AOSERP objectives of identifying the nature of interactions among various components of the environment and those of proposed development and reclamation activities, and predicting the cumulative effects of anticipated developments on the environment. Work in 1977-78 consisted mainly

of completing analysis of the remote sensing imagery and a final report on the project. Field studies in which data from vegetation plots were acquired and compared to imagery (small and large scale false colour infrared imagery, and large scale true colour and thermal infrared imagery) were concentrated in two areas: Mildred Lake north to the MacKay River; and the area southwest of Gregoire Lake. Logistics prevented the acquisition of three different scales of imagery at three different times of year as originally planned; the 1976 imagery flown for the project was acquired in the fall. Vegetation communities were identified from ground plots and compared to imagery. It was concluded that false colour infrared aerial photography acquired during the period of maximum foliage development is most valuable for vegetation mapping and detection of environmental disturbance. Thermal infrared night imagery was found to be valuable for detecting thermal anomalies related to water features, and in the analysis of oil sands plant sites. LANDSAT colour composite transparencies were excellent in providing an overview of major ecological communities and the progress of land clearing while LANDSAT digital data were best for change detection analysis of water, cleared land, and disturbance vegetation.

REPORT:

The final report contains information on: the vegetation communites and the ability of the various types of imagery to detect these communities; detection of environmental disruptions with thermal infrared imagery; satellite imagery; spatial information systems; techniques; and environmental monitoring. The draft of the final report is being revised by the author.

TF 8.1
Baseline States -- Insect Fauna

RESEARCHER: Dr. A. Nimmo

AFFILIATION: AOSERP

DESCRIPTION:

A preliminary investigation of insect fauna in the AOSERP study area is required to assess the relative importance of insect fauna to the environment of the area. This project was initiated in February 1978.

OBJECTIVE:

The 1977-78 objective for this project was to determine the needs for research on aquatic insect fauna in the AOSERP study area. This determination will involve analyses of the current state of knowledge, the fundamental importance of aquatic insect fauna to the biological community, the probabilities of interactions of aquatic insect fauna with reclamation activities, the use of aquatic insect fauna as biomonitoring organisms, and investigations required to fill information gaps.

STATUS:

Due to logistical problems, work was initiated only on the aquatic insect fauna in 1977-78. The complexity of the research and lack of previous work in this area required that a problem analysis be completed. Work will proceed on the terrestrial insect fauna problem analysis in the 1978-79 fiscal year. This project relates well to the AOSERP objectives of establishing baseline states and identifying the nature of interactions between various components of the environment and those of proposed development and reclamation activities.

REPORT:

An interim report on the problem analysis is due in August 1978.

WATER SYSTEM

RESEARCH ACTIVITIES, 1977-78

Water System research is intended to describe the baseline states of aqueous systems in the AOSERP study area and to quantify, predict, and verify physical, chemical, and biological changes in those systems resulting from oil sands development. Major objectives of Water System research will be to provide the means of ready identification of the source, nature, quantity, and distribution of waterborne pollutants, as well as to develop methods for restoration of disrupted water bodies or enhancement of others as mitigation measures and methods for biomonitoring and protecting systems in undeveloped portions of the study area.

Research in the Water System in 1977-78 has encompassed studies in the fields of Aquatic Fauna, Hydrology, and Hydrogeology. The general thrust of the research effort has been to describe the baseline states of aqueous ecosystems in the study area prior to entering into a phase of applied research in years four and five of the Program. Baseline studies have included surface water, ground water, and water quality investigations on regional basis as well as aquatic biological studies on a whole watershed ecosystem basis.

Core activities in the Water System have been defined as "baseline states", "applied research", "monitoring techniques", and "restoration". Significant effort was expended in 1977-78 to identify applied research needs to be emphasized in years four and five of the Program. Toxicological effects of aerial emissions and liquid effluents will be central to the research effort. Research needs were also identified in 1977-78 as to possible biomonitoring and stream restoration techniques appropriate to the study area.

The majority of effort in the field of Aquatic Fauna focussed on describing the baseline states of the biological resources and processes in the study area. Investigations on the numbers and distribution of fish in the Athabasca River downstream

of Fort McMurray were continued for an additional year and an investigation of the fish use of the Athabasca and Clearwater rivers upstream of Fort McMurray was initiated in the fall. The fish resources of two major tributary watersheds, the Muskeg River and the Steepbank River, were studied and the significance of these tributaries with respect to fish use on the Athabasca River system was evaluated. To eventually correlate fish populations and distributions that have been defined by these and earlier AOSERP projects, a preliminary study on aquatic habitat mapping was commissioned. This study provided a list of parameters necessary to describe the aquatic habitat of the AOSERP study area.

The baseline states of the invertebrate resources also received attention in selected watersheds. However, these investigations were not entirely baseline state studies as diversities and populations were correlated not only with natural environmental factors but also with preliminary perturbation experiments. Therefore, the beginnings of applied research were made in 1977 by assessing stress on the environment and by developing monitoring techniques. Also, the invertebrate resources of the Athabasca River in the stretch from the vicinity of the Great Canadian Oil Sands (GCOS) plant to Fort MacKay were studied to assess possible effects of surface mining activities on the aquatic fauna in the Athabasca River.

The baseline states of the bacterial and algal resources were considered as a preliminary to an assessment of primary productivity in aquatic ecosystems. One project concerning primary and secondary productivity was closely co-ordinated with the invertebrate studies and, as such, involved some applied research in considering stress effects on bacterial and algal production. Another study on the bacterial assimilative capacity of the Athabasca River was intended not only to describe baseline states of the bacterial resources in that river but also to lead to predicting the capacity of that river to assimilate organic loadings.

Other applied research in Aquatic Fauna included lake acidification and toxicology. A program of acidification on a

test lake in the Experimental Lakes Area (ELA) in Ontario was continued in which the effects of successively lowered pH on the biota and chemistry of a lake ecosystem were studied. A primary factor that caused this project to be assigned to the ELA was the interest, expertise, facilities, and research programs in lake acidification that already existed in that region. Two toxicology projects, begun in 1976-77, which studied the effects on fish of some toxicants associated with oil sands developments were completed: a study of acute and chronic toxicity of vanadium to fish and a study of multiple toxicity of vanadium, nickel, and phenol to fish.

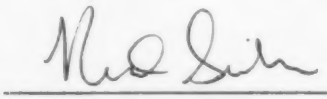
Restoration research has been initiated to a limited extent. Two literature reviews with special reference to the oil sands area were completed: one on the effects of siltation on aquatic biota, and the other on the effects of stream diversion and restoration techniques.

In the field of hydrogeology, two baseline projects were supported: an investigation of the regional groundwater regime was provided with AOSERP field support and an intensive investigation of the shallow groundwater regime of one basin was funded. This shallow groundwater study not only considered the baseline states but it purposed to define processes that might be used to monitor groundwater movements.

In the field of hydrology, the majority of effort was expected in defining the physical and chemical aspects of the aquatic environment. The physical baseline states of water resources were studied by a hydrometric and suspended sediment collection network. Because another aspect of water movement that affects the aquatic habitat is the ability of the Athabasca River to mix and, therefore, dilute effluent, the mixing characteristics of the Athabasca River under ice were studied.

Baseline water quality was characterized extensively in one basin and on a regional basis with a broad list of parameters identified to be of concern for the aquatic habitat. Also, the definition of key parameters and the identification of processes

affecting these parameters are intended to be used for applied research into the stressing of aquatic habitats. Further, the baseline states of organic constituents in the Athabasca River received attention.



R.T. Seidner, Ph.D.
Research Manager
Water System

Water System Projects

AF 2.0.1
Invertebrate Resource Studies of the AOSERP Study Area

RESEARCHERS: Dr. R.R. Wallace and Dr. D. Barton

AFFILIATION: Fisheries and Environment Canada, Fisheries and Marine Service

DESCRIPTION:

This project, which was a continuation of 1976-77 activities of project AF 2.0, was to describe the basic ecology of aquatic benthic macrofauna of the Athabasca River and tributaries within the AOSERP study area. Such basic taxonomic and life cycle data are required to support future manipulative and experimental studies designed to accurately describe and predict changes in benthic communities that can be expected from oil sands development activities. This year's research activities were in the Muskeg, Steepbank, and Athabasca rivers.

OBJECTIVES:

The objectives of this study were:

1. To gather baseline information which quantitatively and qualitatively describes the invertebrate fauna of the Athabasca River, its delta, and its tributaries within the AOSERP study area;
2. To use part of this information to assess the nature and magnitude of the impact from the GCOS facility upon organisms inhabiting the Athabasca River;
3. To describe the responses of benthic communities of the tributary streams to such potential impacts from oil sands development as acidification, hydrocarbon seepages, spills and effluents, siltation, and stream substrate alterations;
4. To relate the standing stocks and population dynamics of the benthic fauna to the fish fauna of the AOSERP study area; and
5. To predict the effects of future oil sands development activities on these fauna.

STATUS:

The distribution and taxonomic composition of the macrobenthic fauna of the Muskeg, Steepbank, and Athabasca rivers were studied. Over 350 invertebrate species were collected and identified and their seasonal and geographical distributions described. The effect of habitat (including oil sands formations) on the diversity of the invertebrate populations and algal and bacterial responses to substrates treated with synthetic crude oil were studied. Both bacterial and algal activities were greatly increased on the oiled substrates in sunlight. Numbers of bacteria per cm^2 increased nine fold on oiled substrates; there was an overall stimulation in algal

biomass on the oiled substrates. The greatest algal change was in the Bacillariophyta which showed a six fold increase in numbers in the presence of oil with concomitant shift in species composition. Also noted were significantly more taxa on the oiled substrates.

Related work on primary and secondary productivity in the Muskeg and Steepbank rivers was carried out under project AF 2.0.2.

REPORT:

The draft final report for this project has been received and is in review.

AF 2.0.2
Primary and Secondary Productivity Studies
of Muskeg Drainages in the
AOSERP Study Area

RESEARCHERS: Dr. R.R. Wallace and Dr. M. Lock

AFFILIATION: Fisheries and Environment Canada, Fisheries and Marine Service

DESCRIPTION:

The 1977-78 fiscal year was the first year of a two-year study. The baseline states of bacteria and algae species present were carried out and population fluctuations of both bacteria and algae were monitored.

OBJECTIVES:

The objectives of this study were:

1. To determine the baseline numbers, biomass, taxonomic composition, and productivity of primary and secondary producers in the sediments, periphyton, and suspended matter of muskeg rivers throughout the year;
2. To determine the input routes of organic and inorganic nutrients via groundwater, etc.;
3. To determine the effects of siltation and stream substrate alterations upon primary productivity and total benthic respiration; and
4. To predict the effects of future oil sands development activities on the lower trophic levels of stream communities.

STATUS:

Since the microbial component of a river ecosystem is a key agent in determining the assimilative capacity of that river, this component is probably responsible for utilization of naturally occurring hydrocarbons in streams of the AOSERP study area and could

play a role in utilization of anthropogenic sources of hydrocarbons. Also, the predominance of rivers with sources in muskeg regions in the study area makes their study appropriate.

Most algae and bacteria were found attached to rock surfaces as opposed to being suspended in the river; it appeared that, at least in the case of the algae, the phytoplanktonic forms were primarily benthic species. One hundred and twenty five species of algae were identified in the Muskeg and Steepbank rivers. Principal peaks of bacteria and biomass occurred in early summer and early winter, while minima occurred in August.

This study is co-ordinated with AF 2.0.1, which examines primarily the invertebrate portion of the aquatic ecosystem of muskeg rivers. The groundwater contribution to the Muskeg River basin was studied by HG 1.1 and the surface water chemistry and hydraulics of this basin by HY 2.5. The fish populations and habitat were studied by project AF 4.5.1

REPORT:

The draft final report for this project has been received and is in review.

AF 2.3.1
Studies on Acidification and Heavy Metal Cycling in Lakes

RESEARCHERS: Dr. D.W. Schindler, D. DeClerq, and A. Chalanchuk

AFFILIATION: Fisheries and Environment Canada, Fisheries and Marine Service

DESCRIPTION:

This project, which is in its second year, was intended to assess the effects on lake productivity, fish physiology and toxicity, and heavy metal mobilization of lowering pH of lakes. Lake 223, a typical softwater lake in Canada, is being acidified over a period of several years by quantitative additions of sulphuric acid. Changes in biotic communities and the mechanisms for the changes were studied. Studies of combinations of metals and acid were conducted in 10-m diameter tubes of approximately 200 m^3 capacity to evaluate such effects. Changes in the physiology of sensitive fishes and crustaceans in response to acidification, including fertilization, hatching, embryonic and juvenile development, growth, calcium metabolism, and water balance were also studied.

OBJECTIVES:

The objectives of this project were: to assess the effects on lake productivity of lowering the pH of the lake; to assess the effects on fish physiology and toxicity of lowering the pH of a lake; and to assess the effects on heavy metal mobilization of lowering the pH of a lake.

STATUS:

Significant quantities of acid precipitation and heavy metals emanating from oil sands plants might be subject to long-range transport, and might have adverse effects on softwater lakes in northeastern Alberta and northwestern Saskatchewan. Most species of plants and animals in softwater lakes are cosmopolitan in distribution. Therefore, it was considered to be more economical to carry out whole-lake experimental studies in northwestern Ontario, where the Experimental Lakes Program has the necessary experimental control over the watersheds of softwater lakes and where several years' background data for lakes of the area allow subtle changes due to acidification to be distinguished, with a high degree of certainty, from natural variations.

The only observable chemical effect in the first year of this project was the halving of dissolved inorganic carbon; no short-term biological effects were observed. Mass balance calculations indicated two possible mechanisms in addition to dissolved bicarbonate which buffer the lake system: lake sediments and dissolved colloids (humic substances). Pilot experiments in experimental tubes showed that aluminum, iron, manganese, zinc, thorium, and possibly cadmium were mobilized from sediments as the pH dropped to 6.

It is intended that information generated by this study could eventually be used in conjunction with the results of a 1976-77 study on the potential of lakes in the AOSERP study area for acidification (HY 2.2), together with baseline water quality and air quality data, to predict the effects of various oil sands development schemes.

REPORT:

The interim report for this project, which was due 1 March 1978, has not been received.

AF 2.5.1
Ecology and Life Cycle of Invertebrates in Hartley Creek

RESEARCHERS: Dr. R. Hartland-Rowe, Dr. R. Davies, R. Crowther, and M. McElhone

AFFILIATION: University of Calgary

DESCRIPTION:

This project, which was completing a two year study, was designed to provide detailed information on the ecology and community structure of benthic invertebrates in Hartley Creek, a tributary of the Muskeg River. As well, it was to provide baseline information on the principal invertebrates in the stream and their interrelationships with each other and their physical-chemical environment.

OBJECTIVES:

The objectives of the community studies were:

1. To quantitatively define the invertebrate community structures of pools and riffles in Hartley Creek;
2. To determine the microdistribution of the major invertebrate components of each community;
3. To quantitatively define these components of the community; and
4. To assess the principal interactions between components of the communities.

The objectives of the life cycle studies were:

1. To identify the invertebrate species of Hartley Creek;
2. To determine the temporal and spatial distribution and abundance of the major invertebrate species of Hartley Creek;
3. To determine the life-cycles of the major invertebrate species in Hartley Creek; and
4. To determine the species composition, significance, and variability of aquatic invertebrate drift in Hartley Creek on a diel and seasonal basis.

STATUS:

The focus of this project was collection and analysis of baseline data. One must first know the identification, enumeration, and interrelationships of invertebrates with each other and their environment before one can design experiments to stress the environment to assess the impacts of development.

Work on quantitative analysis of the microdistribution, density, biomass, and production of the principal invertebrates in riffles in Hartley Creek is in progress. A preliminary study of streamflow velocity, gross inorganic substrate type, preliminary light intensity, and feeding information has been carried out. Preliminary results show that trichoptera feed primarily on algae with some indications of bacterial digestion.

Related work on the invertebrate resources in the area was carried out by projects AF 2.0.1 and AF 2.0.2.

REPORT:

A draft final report is in review.

AF 2.6.1
Assimilative Capacity of the Athabasca River Due to Microbial Degradation of Organic Compounds

RESEARCHERS: P. Nix, R.B. Murray, J.W. Costerton, R. Ventullo, and R.T. Coutts
AFFILIATION: Chemical and Geological Laboratories, Microbios, Xenotox

DESCRIPTION:

This project was intended to develop a biological model of the Athabasca River system that includes the rates of nutrient uptake; this model was to be used to determine the capacity of microbes to remove organic compounds and to predict the effects of oil sands development activities in the Athabasca River.

OBJECTIVES:

The objectives of this study were:

1. To produce a thorough and definitive review of literature on: (a) the assimilative capacity of river systems due to microbial degradation of organic compounds and (b) the methods for measurement of nutrient uptake by microbial populations;
2. To determine total numbers and define physiological groups of microbes upstream from the Athabasca Oil Sands deposit and to assess the effects of passage, on a seasonal basis, through this formation on these parameters; and
3. To determine the rates of nutrient uptake by physiological groups of microbes in the Athabasca River system on a seasonal basis.

STATUS:

No contract was available for this fiscal year.

Related work on organic compounds in the Athabasca River is described in project HY 3.1.2. Previous work in a similar vein included projects HY 3.1.1, HY 3.1, and HY 2.6.

REPORT:

An interim report for this project will be required in 1978.

AF 3.5.1
Acute and Chronic Toxicity
of Vanadium to Fish

RESEARCHERS: Dr. J.B. Sprague, D.A. Holdway, and D. Stendahl

AFFILIATION: University of Guelph

DESCRIPTION:

This project, whichwas in the final year of a two year study, was to establish thresholds for acute and chronic toxicity of vanadium for fish. This information would assist the Program in determining whether vanadium entering the aquatic environment in the AOSERP study area constitutes a problem.

OBJECTIVES:

The objectives of the acute toxicity tests were to obtain firm numbers on vanadium lethality to allow assessment of danger in comparison to other pollutants, and to obtain a quick measure of toxicity in all types of water to be encountered to point out any peculiarities of vanadium effects.

The objective of the chronic toxicity tests was to detect any long-term or sublethal effects which might affect fisheries production; one-generation experiments with fish should show any effect, whether it results from accumulation, chronic morbidity, effects on reproductive capacity, growth, or other modes of action.

STATUS:

Because of the significant vanadium content of oil sands ore, traces of vanadium are inevitably loaded into the water courses in the oil sands mining areas either through stack emissions, plant process water discharge, or mine depressurization water discharge. Although the extent of the problem this might cause is based largely on the toxicity of vanadium to aquatic fauna, little was known about this topic prior to the inception of this project.

The lethality of vanadium concentrations of 2.4 and 5.6 mg/L to rainbow trout was studied over a variety of values of water hardness and pH. The LC50 calculated from the results of these tests varied from 5.16 to >14.35 mg/L for trout in one week exposures. Also, very young fry of American flagfish showed 28 day LC50's from 0.9 to 1.9 mg/L according to size and age of the fish. Trout, flagfish, and zebrafish all showed similar resistance to lethal effects of vanadium.

In chronic exposures of flagfish to vanadium, the egg-fry stage was the most sensitive one in the life cycle and mortality of such fry was the most obvious effect. At 0.17 mg/L vanadium, which did not cause mortality, there were marginal effects of growth of second-generation fry but no observable effects on older fish. Even these concentrations are well above present concentrations of vanadium in water courses around oil sands development.

Therefore, it was concluded that vanadium is of only moderate toxicity and does not appear, at this time, to pose immediate danger during the oil sands operations.

REPORT:

A draft final report for this project has been received and is in review.

AF 3.6.1
Multiple Toxicity of Nickel, Vanadium and Phenol to Fish

RESEARCHERS: Dr. P. Anderson and P. Spear

AFFILIATION: Concordia University

DESCRIPTION:

This project, which was in the final year of a two year study, was to provide a comprehensive and demonstrable rationale for formulating effluent and/or receiving water quality criteria to safeguard aquatic organisms from mixtures of nickel, vanadium, and phenol.

OBJECTIVES:

The objectives of this study were:

1. To establish criteria safeguarding fish from toxic effects of mixtures of three discrete contaminants (aspects of the lethal and sublethal toxicity of each toxicant were being investigated);
2. To evaluate the results to determine the predictability of the toxicity of their mixtures; and
3. To demonstrate whether the mechanisms of lethal toxicity of certain mixtures are correlated with their respective sublethal actions.

STATUS:

The Athabasca Oil Sands ore contains significant traces of nickel and substantial traces of vanadium. Various phenolic compounds are also present; there is the possibility that substantial amounts

of phenolic compounds can be discharged into the environment either by natural leaching or by industrial process water discharge. In the current industrial process (the Clark hot water process), phenolic compound content could be enriched by the alkali extraction process. Because of the possibility of synergistic action of these toxicants on aquatic biota, the concentrations of all three toxicants in water courses around oil sands development could be independently within acceptable criteria, but the combinations, even at low concentrations, could be highly detrimental to the aquatic biota.

The project should also help to indicate the causes for toxicity of saline mine depressurization water because of the presence of significant vanadium, nickel, and phenol concentrations in these discharge waters. The acute toxicity of whole saline groundwater to fish and aquatic invertebrates was studied during 1976-77 in AOSERP project AF 3.2.1.

REPORT:

The interim report for this project, which was due December 1977, is overdue.

AF 4.3.2
Biological Sampling and Tagging of the Major Fish Species in the Athabasca River

RESEARCHERS: W.A. Bond and D. Berry

AFFILIATION: Fisheries and Environment Canada, Fisheries and Marine Service

DESCRIPTION:

This project, which was in the second year of a two year study, was intended to describe the baseline states of the fish resources of the Athabasca River mainstem downstream from Fort McMurray to the Athabasca Delta. Through a systematic field sampling program the fish populations were described in terms of their relative and seasonal abundance. Information was collected concerning the life history and general biology of the various fish. Routes and timing of migration for major fish species were being determined through a conventional tagging program.

OBJECTIVES:

The objectives of this project were:

1. To ascertain the seasonal distribution and relative abundance of major fish species in the Athabasca River within the AOSERP study area;

2. To identify the migration patterns throughout the open water period for major fish species through a conventional tagging program;
3. To document the timing of the downstream movements of fry in the Athabasca River;
4. To identify possible spawning areas in the Athabasca River and in tributary streams through the presence of ripe and/or spawned-out fish, and presence of eggs and fry;
5. To increase the data base with respect to age, growth, sex ratio, maturity, fecundity, and food habits of the major fish species that frequent the Athabasca River;
6. To define species composition with relative abundance of major fish species present in the Athabasca River under winter low-flow conditions; and
7. To co-ordinate field activities, data analysis, and data interpretation with fisheries studies undertaken for the Peace-Athabasca Delta Monitoring Group in 1977-78.

STATUS:

During 1976-77, field work was limited to the 134 km stretch of the Athabasca River between Fort McMurray and the Firebag River confluence. This year the program was extended to cover two 80 km reaches of the lower Athabasca River including a reach in the Athabasca River delta. Utilization of the Athabasca River was highly seasonal for all major species. Detailed life histories were investigated for goldeye, walleye, lake whitefish, northern pike, longnose sucker, white sucker, trout-perch, flathead chub, lake chub, emerald shiner and spottail shiner. A final report will highlight key information obtained from the two years field work.

Fisheries investigations in two tributaries of the Athabasca River are described in AF 4.5.1 (Muskeg River) and AF 4.5.2 (Steepbank River).

REPORT:

A draft interim report for this project has been received and is in revision.

AF 4.4.1
A Study of Aquatic Habitat Mapping

RESEARCHERS: Dr. A. Brown, Dr. R. Robarts, J. Park, and M.J. Kent

AFFILIATION: Schultz International Limited, Vancouver, B.C.

DESCRIPTION:

The project was intended to provide preliminary direction for describing the aquatic habitat in the AOSERP study area by producing a key for mapping the aquatic habitat and reviewing, evaluating, and recommending appropriate methodologies.

OBJECTIVES:

The objectives of this study were:

1. To develop a list of characteristics that will provide an adequate description of the aquatic habitat in the AOSERP study area;
2. To compile a key based on the parameter list including symbols and annotations suitable for mapping the aquatic habitat of the AOSERP study area at a scale of 1:50,000; and
3. To review and evaluate field study, aerial photography, and ground truthing techniques and recommend methodologies appropriate to the AOSERP study area.

STATUS:

A number of investigations on the aquatic fauna of the oil sands area, particularly in line with an inventory approach, have been conducted by AOSERP, government, and the consulting industry. For example, fish in the Athabasca River were investigated in 1976-78 (AF 4.3.2, AF 4.8.1), and fish in the Muskeg and Steepbank rivers were investigated in 1977-78 (AF 4.5.1 and AF 4.5.2). The available data suggest nonrandom utilization of both the main stem rivers and their tributaries by fish populations.

Another consideration is the importance of the AOSERP study area to the entire Athabasca River system, including its delta and Lake Athabasca, because of fish migration patterns. It is essential to protect this system from any detrimental effects that might be caused by oil sands development. Therefore, an understanding of habitat requirements of fish is essential to maintain the use of this system by fish.

This project was the first step toward habitat characterization and was intended to provide guidelines to the ongoing AOSERP researchers in their studies of aquatic biota. Background review material has been provided in mapping parameters and key development, remote sensing procedures, and computerized mapping.

REPORT:

A draft final report for this project has been received and is in revision.

AF 4.5.1
Intensive Study of the Fish Fauna of the Muskeg River Watershed

RESEARCHERS: W.A. Bond and B. Corbett

AFFILIATION: Fisheries and Environment Canada, Fisheries and Marine Service

DESCRIPTION:

This project was the second year of a two year project designed to describe the baseline states of the fish resources and the aquatic habitat of the Muskeg River watershed and to provide a quantitative estimate of the significance of the watershed to the fisheries of the Athabasca River system. Monitoring and quantification of migrating fish using the watershed was accomplished by a two-way fish counting fence and tagging while resident fish populations were evaluated by seining.

OBJECTIVES:

The objectives of this study were:

1. To enumerate the migrant populations of arctic grayling, longnose sucker, white sucker, and other fish populations that use the Muskeg River on a seasonal basis;
2. To increase the data base with respect to age, growth, sex ratio, maturity, fecundity, and food habits of these and other fish populations that frequent the Muskeg River watershed;
3. To identify more fully parts of the Muskeg River watershed used by non-resident fish species as spawning, nursery, and feeding areas;
4. To monitor the downstream movements of the fry of various fish species hatched within the Muskeg River watershed and to estimate recruitment of these species in the Athabasca River system;
5. To define further the distribution, relative abundance, and general biology of resident fish species in the Muskeg River watershed;
6. To describe, in detail, the aquatic habitat of the Muskeg River watershed; and
7. To apply conventional (Floy) tags to migrant fish to permit definition of their migration routes within the Athabasca River system.

STATUS:

Enumeration of fish using the Muskeg River continued for an additional year. An interim report on the 1976-77 activities has been published (AOSERP Report 26). During 1977-78, a two-way fish counting fence was operated near the mouth of the Muskeg River from 28 April to 15 June. Of the 5,275 fish migrating upstream during this time, 56% were white sucker, 31% longnose sucker, 8% northern pike, 3% arctic grayling, and 1% mountain whitefish. Although the percentage of grayling detected was low, the pattern appeared to be the same as in the Steepbank River. A number of grayling were captured by angling into October, indicating the need for a fall fence to obtain a better estimate of the occurrence of this species.

A final report that will correlate habitat considerations with the fish populations will be produced in fall 1978. Related work on the Steepbank River is described in Project AF 4.5.2. In 1978-79 the MacKay River basin is to be studied. These types of tributary investigations form part of a long term plan to characterize the fisheries resources provided to the Athabasca River system.

REPORT:

The final report for this project has been received and is in revision.

AF 4.5.2
Intensive Study of the Fish Fauna and Aquatic Habitat of the Steepbank River Watershed

RESEARCHERS: W.A. Bond and K. Machniak

AFFILIATION: Fisheries and Environment Canada, Fisheries and Marine Service

DESCRIPTION:

This was a one-year study designed to define the baseline states of the fish resources and the aquatic habitat of the Steepbank River watershed and to provide a quantitative estimate of the significance of this watershed to the fisheries of the Athabasca River system. Monitoring and quantification of migrating and resident fish utilizing the watershed was accomplished by a two-way counting fence and seining.

OBJECTIVES:

The objectives of this study were:

1. To enumerate the migrant populations of those fish species utilizing the Steepbank River watershed on a seasonal basis;
2. To describe the timing of the seasonal and daily movements of various fish populations into and out of the Steepbank River watershed and to obtain information concerning the age, growth, sex ratio, fecundity, food habits, etc., of these fish;
3. To determine the extent of movement of the various non-resident fish populations within the Steepbank River watershed and to locate spawning and nursery areas;
4. To apply conventional (Floy) tags to migrant fish to permit definition of their migration routes within the Athabasca River system;
5. To monitor the downstream migration of fry of various species hatched within the Steepbank River watershed and to estimate recruitment of these species to the Athabasca River system;
6. To assess the resident fish species of the Steepbank River watershed in terms of relative abundance, distribution, and general biology; and
7. To describe, in detail, the aquatic habitat of the Steepbank River watershed.

STATUS:

Evaluation of the fisheries resources of the Steepbank River was accomplished. A two-way counting fence was operated both in the spring (25 April to 29 May) and the fall (12 September to 15 October) near the mouth of the Steepbank River. Of the 7,272 fish migrating into the river during the spring, 52% were longnose sucker on spawning runs, 20% arctic grayling on spawning and summer feeding runs, 15% white sucker, 7% mountain whitefish, and 3% northern pike. During the fall there was very little in-migration; of the 2,265 fish migrating out of the Steepbank River, 79% were arctic grayling, 11% white sucker, and 5% longnose sucker. The resident fish fauna of the Steepbank River consisted of pearl dace, brook stickleback, lake chub, longnose dace, and slimy sculpin. Also, the young-of-the-year grayling remain in the tributary throughout the summer; they probably spend their first winter in the tributary and leave at the end of their second summer.

Related data on the Muskeg River are described in Project AF 4.5.1. In 1978-79, the MacKay River basin is to be studied. These tributary investigations form a part of a long term plan to characterize the fisheries resources provided to the Athabasca River system.

REPORT:

A final report on the Steepbank River basin has been received and is in revision.

AF 4.8.1
Fisheries Investigation of the Athabasca and Clearwater Rivers Upstream from Fort McMurray

RESEARCHERS: Dr. P. McCart, M. Jones, and G.J. Mann

AFFILIATION: Aquatic Environments Limited

DESCRIPTION:

This project served to establish baseline states of the fish resources in the Athabasca and Clearwater rivers upstream from Fort McMurray. The study documented the importance of these reaches to fall spawning lake whitefish populations relative to the entire Athabasca River system, including Lake Athabasca.

OBJECTIVES:

The objectives of this study were:

1. To determine the species composition, relative abundance, and biology of major fish species in the Athabasca and Clearwater rivers upstream from Fort McMurray to the southern boundary of the AOSERP study area;
2. To identify the migration patterns of major fish species with special emphasis on lake whitefish;
3. To delineate actual and potential spawning areas in the Athabasca and Clearwater rivers for lake whitefish; and
4. a) to follow the development of lake whitefish eggs with particular reference to the time at which they reach critical stages;
   b) to monitor physical and chemical conditions (temperature, dissolved oxygen, water depth, flow rates, ice thickness, substrate characteristics, etc.) on the spawning grounds; and
   c) to determine whether a significant portion of the eggs have been deposited in areas that are subsequently frozen.

STATUS:

Large runs of fall spawning lake whitefish were documented in the first two weeks of October. The lake whitefish concentrated in large numbers below Mountain Rapids (25 km upstream of Fort McMurray on the Athabasca River) and small concentrations occurred below Cascade Rapids (32 km upstream of Fort McMurray on the Athabasca River). Tag returns indicated that lake whitefish moved out of the spawning area and down the Athabasca River toward the delta and Lake Athabasca soon after spawning.

Some spawning areas were sampled for eggs. Highest densities of eggs were detected immediately downstream of Mountain Rapids. Substrates where eggs were found ranged from rock and boulder to broken rock substrates.

Since the spawning runs of Lake Athabasca whitefish traverse the stretch of the Athabasca River most likely to be affected by oil sands surface mining developments, the maintenance of good habitat in the Athabasca River is of prime concern. Other fisheries studies on the Athabasca River system included project AF 4.3.2.

REPORT:

A draft final report for the project has been received and is in review.

AF 4.9.1
Review of Effects of Sedimentation on the Aquatic Biota

RESEARCHERS: W. Griffiths and B. Walton

AFFILIATION: Renewable Resources Consulting Services Limited

DESCRIPTION:

This study was to review published literature on the effects of naturally occurring silt scour and deposition, and the transient and long term effects of artificially increasing the suspended sediment load in waterbodies. Special attention was made to possible effects of siltation from oil sands development activities on aquatic biota. The study produced an annotated bibliography having special reference for the AOSERP study area on the subject.

OBJECTIVES:

The objectives of this project were to review published literature on the effect of silt on aquatic biota and to produce an annotated bibliography on the subject having special reference to the AOSERP study area.

STATUS:

A final report on the project has been submitted. The review, with special reference to the AOSERP study area, includes effects of sedimentation on aquatic biota, recovery of aquatic biota from increased sedimentation, applications of biomonitoring and remote sensing, and effects of sedimentation from oil sands development activities on aquatic biota.

Recommendations for further study include laboratory studies and a series of controlled sedimentation experiments to

evaluate the effects of chronic sedimentation on the aquatic biota, and monitoring the rate of soil erosion of road cuts, including assessment of impact of eroded material on aquatic biota in downstream channels.

REPORT:

The final report for this project has been distributed.

AF 4.9.2
Review of Stream Diversion and Stream Restoration Techniques and Associated Effects on Aquatic Biota

RESEARCHERS: C.B. Sikstrom and J.A. Martin

AFFILIATION: Envirocon Limited

DESCRIPTION:

This project was to review the published literature on the effects of permanent and temporary stream diversion and successful stream restoration techniques on aquatic biota. Special attention was made to possible effects of stream diversion and restoration from oil sands development activities on aquatic biota. The review highlighted the use of biomonitoring and remote sensing techniques to assess effects on aquatic biota as well as published information on the natural ability of waterbodies to recover from stream diversion and restoration practices. An annotated bibliography on the subject, having specific reference to the AOSERP study area, was to be produced.

OBJECTIVES:

The objectives of this project were to review the published literature on the effects of permanent and temporary stream diversion and successful stream restoration techniques on aquatic biota, and to produce an annotated bibliography on the subject, having special reference to the AOSERP study area.

STATUS:

The review, with special reference to the AOSERP study area, includes effects of stream diversions on aquatic life, natural recovery of stream ecosystems from the effects of diversion, effectiveness of habitat restoration or enhancement techniques, and potential applications of biomonitoring techniques for studying the

effects of diversions. The references pertaining to these topics are compiled in an annotated bibliography.

The report recommends collection of as much information as possible about the effects of the Beaver Creek diversion to aid in planning future diversion projects in the AOSERP study area. Recommended studies should centre on main water bodies and associated wetlands. Data collected should include changes in discharge, water level, water temperature, suspended sediment load, channel stability, bank morphology and vegetation, and floral and faunal population structures. Monitoring of fish populations above the diversions should be done. In wetland areas, vegetation succession initiated by water level changes should be monitored and related to bird or mammal population changes.

REPORT:

A draft final report has been received, and is in review.

HG 1.0
Regional Hydrogeology of the Athabasca Oil Sands

RESEARCHER: Dr. D. Hackbarth

AFFILIATION: Alberta Energy and Natural Resources, Alberta Research Council

DESCRIPTION:

This project, which continued from 1976-77, was designed to develop a hydrogeological response model for the Athabasca Oil Sands area. Such a model will provide a reliable framework which is necessary for the solution of technical problems related to oil sands development activities involving groundwater. Although this was not an AOSERP project, AOSERP support service facilities and technical advice were utilized. Funding was by Alberta Energy and Natural Resources.

OBJECTIVE:

The objective of this project was to develop a hydrogeological response model for the Athabasca Oil Sands area.

STATUS:

Observation wells in the AOSERP study area were monitored monthly for water levels and annually for water quality. Data

publications will be updated. Procedures for digitization, storage, and retrieval of water level hydrographs are nearing completion.

REPORT:

Results of this study are to be published in an Alberta Research Council Bulletin.

HG 1.1
Hydrogeological Investigation of the
Muskeg River Basin

RESEARCHER: Dr. F.W. Schwartz

AFFILIATION: University of Alberta

DESCRIPTION:

Thirty-six piezometers or watertable observation wells were emplaced at 28 sites in the Hartley Creek watershed. Samples for chemical analysis were collected from the wells. Analysis of water chemistry data, water level data, and drawdown data was accomplished and related to concurrently collected information. This was the second year of a three-year project.

OBJECTIVES:

The objectives of this project were:

1. To collect and interpret published hydrogeological data for the Muskeg River basin;
2. To collect and interpret field hydrogeological data that may be easily obtainable for the watershed;
3. To evaluate the role of muskeg in the groundwater regime;
4. To interpret chemical parameters of streamflow collected at the basin outlet by the Hydrology Technical Research Committee and relate these and existing streamflow chemical data to features of the groundwater system; and
5. To develop groundwater models capable of providing the means to study the characteristics of shallow, near-stream groundwater systems.

STATUS:

Over a large area of the Muskeg River basin, less than 30 m of glacial drift overlies thick oil sand deposits. Spruce-muskeg and bog covers much of this overburden. Although it is expected that mining and extraction will begin on leases within

the basin in the next few years, very little is known about muskeg groundwater regimes. The goal of this research was to define more clearly muskeg shallow groundwater conditions adjacent to streams to assist in the planning of diversions of surface disruption.

A technique for streamflow hydrograph separation using water chemistry parameters was developed to predict the contribution of shallow groundwater.

It was determined that, when not frozen, the muskeg stores a mixture of precipitation water, surface run-off, and ground water, whereas in typical watersheds the precipitation is stored for only a short time after a rainstorm or snowmelt.

During the next year (1978-79), further application of these techniques will be tested in the Muskeg basin. Concurrent with this study was an intensive water quality sampling project in the Muskeg River basin (HY 2.5) and a study on primary and secondary productivity (AF 2.0.2).

REPORT:

An interim report for this project has been received, and is in revision.

HY 1.1
Hydrometric Data Collection for the Regional Characterization of Streamflow

RESEARCHERS: M. Spitzer and K.D. Loeppky

AFFILIATION: Fisheries and Environment Canada, Water Survey of Canada

DESCRIPTION:

This project, in the third year of a five year term, was to provide adequate streamflow information for an inventory of hydrology resources of the AOSERP study area.

OBJECTIVES:

The objectives of this study were:

1. To provide adequate streamflow information in support of hydrologic studies, such as those of chemical constituent loadings, sediment discharges, and design information for engineering works;

2. To provide adequate streamflow information in support of water survey studies designed to determine if there is sufficient water to meet the needs of industry, urban development, and reclamation;
3. To provide adequate streamflow information for the determination of the frequency of flood flows; and
4. To obtain adequate streamflow information for the calibration and validation of water quality models.

STATUS:

Hydrometric data were collected at 32 hydrometric gauging stations in and near the AOSERP study area. Four of the stations monitored lake levels (Namur, Gardiner, Eaglenest, and Gregoire lakes). Most of the stream stations, which cover all types of catchment basins in the study area, were instrumented with a recording manometer; this system provided water level measurements on a continuous basis. Normally, on-site streamflow measurements were taken at monthly intervals at each stream. These measurements were used to define the stage (level)-discharge relationship and to measure any deviations from the established stage-discharge curve.

Hydrometric data provide strong support for water quality and related modelling studies (HY 2.5, HY 2.8.1, HY 3.1.2, AF 2.6.1). One ultimate intention of such studies is to relate key water quality parameters to various aspects of the natural hydrological cycle as well as oil sands development effects.

Some preliminary findings have been published in AOSERP Report 18.

REPORT:

The interim report for this project has been received and is in review.

HY 1.3
Suspended Sediment Collection and Analysis

RESEARCHER: M. Spitzer

AFFILIATION: Fisheries and Environment Canada, Water Survey of Canada

DESCRIPTION:

Depth-integrated sediment samples were collected at four stations on a daily basis and 10 stations on a monthly basis.

Laboratory analysis for total concentration was carried out on all samples and for particle size distribution on all samples with sufficient material. This fiscal year was the third year of a five year collection of sediment data.

OBJECTIVE:

The objective of this project was to provide background information on the temporal distribution of suspended sediment concentration and discharge in streams within the AOSERP study area.

STATUS:

There is a likelihood that development of the oil sands mining areas will greatly alter the suspended sediment loadings of the water courses in the AOSERP study area. Mining activities and stream diversions usually cause increases in siltation and suspended sediments carried by streams, whereas impoundments will decrease siltation downstream of the impounding structure. Such alterations greatly affect the aquatic environment for many aquatic fauna (see project AF 4.9.1).

This project was to provide adequate information on the distribution of naturally occurring suspended sediment concentration and discharges in streams within the AOSERP study area.

REPORT:

The interim report has been received and is in review.

HY 1.4.3
Mixing Studies in the Athabasca River and Delta--Winter Conditions in the River

RESEARCHERS: Dr. S. Beltaos, P. Doyle, V. Arora, and W. Lipsett

AFFILIATION: Alberta Research Council

DESCRIPTION:

The project was initiated to assess the ability of the Athabasca River in the AOSERP study area to mix point source effluent streams during ice conditions. A dye was injected into the Athabasca River and samples were withdrawn downstream at various points and analyzed for the concentration of dye.

OBJECTIVES:

The objectives of this project were:

1. To develop a procedure and use it to determine the mixing characteristics of a selected study reach of the Athabasca River in the AOSERP study area over a range of winter flow conditions for effluences when differential density is not a factor;
2. To estimate the mixing characteristics of all sections of the Athabasca River in the AOSERP study area including time-of-travel, longitudinal mixing, and transverse mixing under a representative range of winter flow conditions; and
3. To develop a preliminary procedure and use it to determine the mixing characteristics of a selected reach of the Athabasca River under winter flow conditions when effluence density and temperature are factors.

STATUS:

One important geomorphic feature of the Athabasca River in the oil sands surface mining area between Fort McMurray and Embarass is the relatively straight channel. In this type of channel the degree of mixing of an effluent plume would be less than in a typical meandering channel; therefore, discharges from oil sands developments would not receive dilution for a long distance downstream. Because a concentrated effluent plume could constitute a danger to migrating fish (AF 4.3.2, AF 4.8.1), an assessment of the transverse and longitudinal mixing characteristics is necessary.

Two dye injection tests were run: a continuous injection test and a slug injection test. The continuous injection test was designed to establish a transverse mixing coefficient for this reach of the Athabasca River. The slug injection test was designed to time travel and longitudinal mixing downstream of the injection site. The time of arrival of the slug, which was injected 6.8 km below the mouth of the Ells River, at the mouths of the three main distribution channels of the Athabasca River was 191 to 193 hours.

REPORT:

The report for this project has been received and is in revision.

HY 2.5
Intensive Water Quality Survey of the Muskeg River Watershed

RESEARCHERS: Dr. A.M. Akena, C.R. Froelich, and Dr. R. Seidner

AFFILIATION: Alberta Environment, Environmental Protection Services

DESCRIPTION:

This was the last year of a two-year project designed to obtain an understanding of the natural water quality loadings and processes in the Muskeg River basin and to establish baseline conditions of water quality, water flow, suspended sediments, and channel regime for current and future studies.

OBJECTIVES:

The objectives of this project were:

1. To obtain measurements of water quality, water quantity, and suspended sediment collections throughout the basin on a monthly and bi-monthly basis to the end of July 1977, and continue measurements at three sites (to include the Muskeg River near the mouth and Hartley Creek near the mouth) for an additional full year;
2. To determine the relationships among streamflow, conductivity, and major inorganic water quality parameters throughout the basin;
3. To estimate the temporal variation during the year of water quality, water quantity, and suspended sediments at a large number of sites in the basin;
4. To identify the types and sources of significant water quality non-point source loadings in the streams of the basin;
5. To determine the magnitude and significance of diel variations in water quality parameters at one representative site; and
6. To document those hydraulic channel characteristics that can be determined by stream gauging at many reaches throughout the basin.

STATUS:

A substantial portion of the AOSERP study area is covered by spruce-muskeg and bog. The high storage capacity of muskeg has a unique effect on the water quality of streams originating in and passing through these areas. Disruptions of flow to muskeg areas and removal of the overlaying peat bogs by surface mining will impact the water quality of muskeg basins. Therefore, an understanding of the processes in these areas is desirable.

Concurrent to this study was a shallow groundwater study in the Muskeg River basin (HG 1.1) and studies in primary and secondary productivity in this basin (AF 2.0.2).

REPORT:

The final report, which was due March 1978, is overdue.

HY 2.8.1
Regional Water Quality Sampling and Analysis

RESEARCHER: Dr. R. Seidner

AFFILIATION: Alberta Environment, Environmental Protection Services

DESCRIPTION:

This study was the first year of a three year investigation intended to obtain an initial understanding of the natural water quality loadings and processes in the AOSERP study area and establish baseline conditions of water quality for current and future studies.

OBJECTIVES:

The objectives of this study were:

1. To identify significant naturally occurring water quality parameters which should be included in procedures for predicting water quality;
2. To provide data on the variation of water quality parameters over time at the mouths of important stream basins that will be used by future studies to confirm the general accuracy of calibrated water quality models through a comparison of predicted and measured water quality levels;
3. To provide regional baseline water quality data (including the Athabasca Delta area);
4. To provide water quality information for concurrent studies; and
5. To provide a preliminary assessment of the contributions of water originating in or passing through the AOSERP study area on the water chemistry balance of the Athabasca Delta regions around Lake Athabasca.

STATUS:

Water sampling and analyses were conducted at 42 stream, lake, and river sites in the AOSERP study area and in the Athabasca River delta. Two distinctly different drainage basins meet in this region: (1) the Western Canadian Sedimentary Basin and (2) the Precambrian Shield. The water from both basins is dramatically different. Most sub-basins studied typified sedimentary basins and yielded water highly variable in character. Such water is characterized as moderately hard to hard (the Athabasca River varied from 85-203 mg/L $CaCO_3$), turbid, and containing substantial quantities of

filterable and non-filterable residue. Water from the shield area to the east was consistently soft and low in amounts of both filterable and non-filterable residue. Water draining muskeg areas displayed generally higher natural organic parameters and streams affected by water from groundwater discharge displayed trace metals in addition to higher hardness and salinity. A general effect of increased salinity on the Athabasca River near current oil sands developments was detected.

Results of analyses are stored on NAQUADAT coded filing system. In addition, minimum-maximum summaries are now available. As more data become available, seasonal summaries will become available leading to a greater understanding of the natural processes affecting the regional water quality.

REPORT:

The interim report for this project has been received and is in revision.

HY 3.1.2
Water Quality Investigations into the Form of Organic Compounds in the AOSERP Study Area

RESEARCHERS: M. Strosher and E. Peake

AFFILIATION: University of Calgary

DESCRIPTION:

This study, the first year of three years, was designed to obtain baseline information on the natural organic loading of the Athabasca River upstream of the surface mining and to assess the fate of organic matter, from natural or influenced sources, under winter conditions.

OBJECTIVES:

The objectives of this study were:

1. To determine, in terms of organic compounds, the influence of the Athabasca Oil Sands deposit upon the water quality of the Athabasca River upstream of Fort McMurray under wintertime conditions;
2. To investigate the sediments of the Athabasca River upstream of Fort McMurray as a sink for organic compounds;
3. To examine the natural chemical and biological processes whereby the Athabasca River may assimilate additional organic matter contributed to the river by oil sands development;

4. To improve and provide complete documentations on existing analytical techniques as they apply to the analysis of organic compounds in surface, ground, and waste waters in the Athabasca Oil Sands area, with emphasis to be placed on analysis which may be conducted routinely and which may be diagnostic in predicting the effects of surface mining upon the Athabasca River system; and
5. To investigate the physical forms of organic compounds identified from water and sediment samples collected in part of the study.

STATUS:

Investigations were carried out on the Athabasca River upstream of Fort McMurray to determine the baseline quantities of organic constituents and their contribution to the organic water quality of the river system.

Water soluble constituents, tannins and lignins, asphaltenes, and polar constituents were the major organic components of the river system as determined from the 16 different investigations carried out.

Water samples contained an average 9 mg/L of organic carbon, the majority of which was determined as dissolved organic carbon. Water soluble organics, which include the humic acids, averaged 6.9 mg/L and were the largest single component of the river water. Also contained in this water soluble fraction were the naturally occurring tannin and lignins, at a concentration of 0.24 mg/L. The extractable carbon fraction contained 20% asphaltenes, 33% polar constituents, and 10% hydrocarbons.

Sediment samples contained an average of 11,000 to 20,000 mg/kg of total organic carbon, 6% of which occurred as extractable organic carbon. Tannins and lignins were the largest group of compounds detected in the sediments, but comprised only 3% of their unextractable carbon fraction. Extractable organic carbon fractions contained 39% asphaltenes, 17% polar compounds, and 16% hydrocarbons.

On the basis of these investigations, it was concluded that contributions of organic constituents by this segment of the river are mainly water soluble, naturally occurring compounds that persist consistently throughout the study area. Utilization of organic compounds by microorganisms was studied in project AF 2.6.1.

REPORT:

The final report for this project has been received and is in review.

ALBERTA OIL SANDS ENVIRONMENTAL RESEARCH PROGRAM

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Syncrude Canada Limited

E. Tollefson, Ph.D., Head
Department of Chemical Engineering
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Human System

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Director, Social Security Division
Social Services and Community Health

G.G. Archibald
Program Development
Northern Development Branch
Business Development and Tourism

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Planner, Secretariat
Advanced Education and Manpower

G.M. Young
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G. Stephenson, P.Eng.
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G.W. Hodgson, Ph.D.
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C. Niell, P.Eng.
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D. Rosenberg, Ph.D.
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J.P. Verschuren, Ph.D.
Professor of Civil Engineering
Department of Civil Engineering
University of Alberta

B.F. Bidgood, Ph.D.
Section Head
Fisheries Research
Alberta Recreation, Parks and
Wildlife
Fish and Wildlife Division

Figure 2. Meteorological tower at the AOSERP Mildred Lake Research Facility, July 1978 (AOSERP photo).

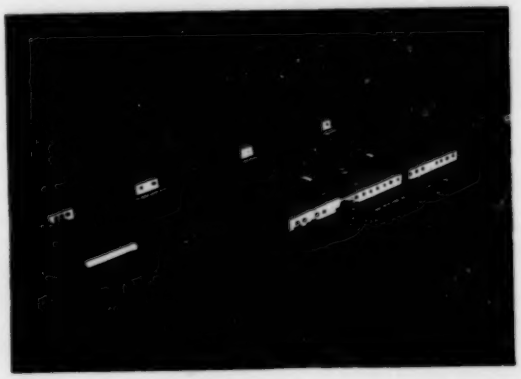

Figure 3. AOSERP Mildred Lake Research Facility (G. Hunter photo).

Figure 4. Seining in the MacKay River (AOSERP photo).

Figure 5. Wolf (L.N. Carbyn photo).

Figure 6. River in the AOSERP study area (J. Jorgenson photo).

Figure 7. Water sampling on the upper Ells River, February 1978 (AOSERP photo).

Figure 8. Releasing a minisonde balloon used for gathering meteorological data (AOSERP photo).

Figure 9. Aerial view in the Peace-Athabasca delta (E.G. Hennan, CWS photo).

Figure 10. Dogteam (M. Fox photo).

Figure 11. Aerial view of Fort Chipewyan, February 1978 (AOSERP photo).

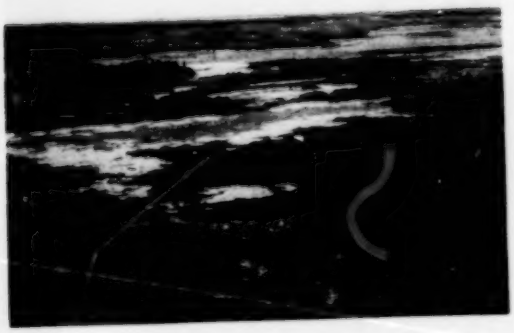

Figure 12. Lake in the AOSERP study area (E.G. Hennan, CWS photo).

Figure 13. Tree planting and seeding on the GCOS dike (AOSERP photo).

APPENDIX I

Canada-Alberta Agreement
for the
Alberta Oil Sands Environmental
Research Program
Amended--September 1977
Office Compilation

THIS AGREEMENT made on the 26th day of September, 1977.

BETWEEN:

THE GOVERNMENT OF CANADA
represented herein by the Minister of the Environment (hereinafter called "Canada")

OF THE FIRST PART

AND:

THE GOVERNMENT OF ALBERTA
represented herein by the Minister of the Environment (hereinafter called "Alberta")

OF THE SECOND PART

WHEREAS Canada and Alberta have agreed to identify, undertake or encourage and assist research into environmental aspects of the renewable resources involved in the development of oil sands in the area in Alberta described in Schedule "C" hereto, and wish by this agreement to provide for the coordinated planning, funding and implementation of such research; and

WHEREAS initial development is now occurring with expansion imminent and decisions on several industrial proposals now are pending; and

WHEREAS the large scale industrial development of the area will have immense economic, social and environmental effects; and

WHEREAS Canada and Alberta recognize the necessity of improving the scientific understanding of the effects of the oil sands development on the human and natural environment of the oil sands area; and

WHEREAS the results of an intensive study of the area will be useful in predicting the effects of any proposed development, as a basis for considering future proposals; and

WHEREAS the results of the study program will be utilized by Alberta in the approval process for future developments and in the environmental design of any project which might be implemented; and

WHEREAS Canada and Alberta are agreed on the objectives, general strategy and procedures which would govern the identification and selection of such research and the methods of encouragement and assistance; and

WHEREAS His Honour, The Lieutenant Governor-in-Council by Order-in-Council No. 887/77 dated 31st August, 1977, has authorized the Minister of the Environment for Alberta to execute this agreement on behalf of Alberta;

NOW THEREFORE THIS AGREEMENT WITNESSETH that in consideration of the premises, covenants and agreements herein contained, the parties covenant and agree with each other as follows:

I. DEFINITIONS

In this agreement

(a) "area" means that part of the Province of Alberta described in Schedule "C" to this Agreement;

(b) "environmental research" means a fundamental investigation of a potential or actual man-induced change in environmental systems, which could result in identifiable benefits or adverse effects to society;

(c) "Federal Minister" means the Minister of the Environment of Canada;

(d) "fiscal year" means the period commencing on April 1st of any year and terminating on March 31st of the immediately following year;

(e) "industry" means an individual company or an aggregate or any number thereof of industrial companies who seek to develop the oil sands;

(f) "Ministers" means the Federal Minister and the Provincial Minister;

(g) "non-renewable resources" means minerals, mineral fuels; and similar resources;

(h) "oil sands" means sands and other rock materials which contain crude bitumen and includes all other mineral substances in association therewith;

(i) "oil sands deposit" means a natural reservoir containing or appearing to contain an accumulation of oil sands;

(j) "Program" means the research activities resulting from this agreement;

(k) "Provincial Minister" means the Minister of the Environment of Alberta;

(l) "renewable resources" means biological resources and resources such as terrain, water, and climate that support biological systems;

(m) "research project" or "project" means a project that is entirely or primarily devoted to conducting research on renewable resources in the area in relation to any matter pertaining to the environment;

(n) "Steering Committee" means the committee established pursuant to paragraph IV (2);

(o) "Senior Advisory Board" means the board established pursuant to paragraph IV (3).

II PURPOSE

(1) The purpose of this agreement is to continue the "Alberta Oil Sands Environmental Research Program".

(2) The purpose of the Program is to provide timely information about factors that will aid the parties in establishing guidelines for socially acceptable limits of damage to present and potential uses of biotic and abiotic resources.

(3) In support of this purpose, Canada and Alberta agree that this agreement is confined to research only and does not involve the management of renewable resources.

(4) The objectives of the Program are attached as Schedule "A" hereto. These objectives may be added to or amended from time to time upon agreement of both parties.

III. TERMS OF REFERENCE

The Terms of Reference relating to the Program are contained in Schedule "B" hereto.

IV. ADMINISTRATIVE ARRANGEMENTS

(1) The Ministers shall approve the terms of specific research in the fields of hydrology, hydrogeology, terrestrial fauna, land matters, vegetation, human environment, aquatic fauna, meteorology, and others to which they may mutually agree.

(2) There shall be established a Steering Committee, which, under the direction of the Ministers, shall be responsible for the composition, coordination and conduct of the Program and shall consist of one member appointed by Alberta who shall have the functions normally performed by a chairman, and one member appointed by Canada. The Steering Committee shall:

(a) meet as its members may determine but in any event shall meet at least once every fiscal year during the currency of this agreement,

(b) recommend to the Ministers for approval any news releases respecting any matter concerning or relating to this agreement or the Program,

(c) annually, and at such other times as it or the Ministers may consider appropriate, reports to the Ministers upon the projects carried out under the Program and the progress accomplished in respect thereto,

(d) arrange a meeting of the Senior Advisory Board at least once each fiscal year or as often as is required in order that policy guidance may be provided for on behalf of interested Government departments of Alberta and Canada,

(e) recommend to the Ministers those technical reports prepared for publication,

(f) assume such other duties and administrative responsibilities as the Ministers may from time to time agree and prescribe.

Each Steering Committee member shall appoint an alternate to represent him at meetings which he cannot attend and shall in writing notify the other member the name of the person so appointed. In the event that the Steering Committee is unable to agree upon any matter, the same shall be submitted to the Ministers for resolution.

(3) The Ministers shall appoint a Senior Advisory Board, as recommended by the Steering Committee. The Chairman of the Steering Committee or a member so designated by him in writing shall be the Chairman of the Senior Advisory Board. Senior Advisory Board representation shall be from the Government departments listed in Schedule "D".

The Senior Advisory Board shall:

(a) assist the Steering Committee in evaluating the relevance and timeliness of existing and proposed research efforts relative to the needs of the departments listed in Schedule "D",

(b) provide the Steering Committee with advice on the purpose, objectives and priorities of the research program,

(c) identify areas of interrelationship with research programs other than those provided for in this agreement.

(4) Alberta shall in consultation with Canada appoint a Program Director and such other supporting staff as may be required from time to time to meet the objectives of the Program. The Program Director:

(a) subject ot the approval of the Steering Committee, may establish technical advisory committees or groups as he may consider necessary to assist specific portions of the Program,

(b) shall be responsible to the Steering Committee for the development and implementation of the research projects aimed at meeting the objectives of the Program,

(c) shall arrange for the provision of field services common to all field research projects involved in the Program including, without limitation, laboratory

space, logistics, vehicles and accommodation,

(d) shall be responsible for scheduling project work to ensure the results thereof are available to the parties hereto as soon as practicable,

(e) shall, subject to the direction and approval of the Steering Committee, be responsible for the preparation of news releases and reports for technical and public information,

(f) may recommend to the Steering Committee that the respective parties hereto, as the case may be, enter into contracts or other arrangements required to meet the objectives of the Program,

(5) The parties hereto shall have regard to any existing programs of Alberta or Canada concerning oil sands environmental research for which the Departments of the Environment of Alberta and Canada are individually or jointly responsible, and agree to coordinate these programs as closely as possible with the implementation of the Program.

(6) Subject to paragraph V (8), Alberta shall be the contact with industry and Alberta universities in matters pertaining to this agreement and which have been recommended by the Steering Committee.

(7) Any provision of this agreement may be amended by mutual agreement.

V. **FINANCING**

(1) The total cost of the Program is estimated to approximate $40,000,000 expended over a period of ten years. For the purpose of this agreement, but subject to paragraphs (2) and (3) of this Article, the terms of this agreement shall be five years from April 1, 1975, unless this agreement is extended or terminated pursuant to Article VI hereof.

(2) Subject to the terms and conditions of this agreement and to funds being appropriated by Parliament, the sum for which Canada shall be liable hereunder shall approximate $2,000,000 annually for five years from the date hereof and thereafter shall approximate $2,000,000 annually for a further period not exceeding five years where the term of the program is extended pursuant to Article VI hereof.

(3) Subject to the terms and conditions of this agreement and to funds being appropriated by the Legislative Assembly of Alberta, the sum for which Alberta shall be liable hereunder shall approximate $2,000,000 or more annually for five years from the date hereof and thereafter shall approximate $2,000,000 or more annually for a further period not exceeding five years where the term of the program is extended pursuant to Article VI hereof.

(4) Prior to the beginning of each fiscal year, the projects to be undertaken by Alberta, Canada, or jointly, for that fiscal year shall be recommended by the Steering Committee for the approval of the Ministers. The Steering Committee may recommend a joint project between the parties hereto, the cost of which shall be borne equally by the parties or as otherwise mutually agreed. Alberta will provide the initial funding for all research projects on the basis of monthly progress claims reviewed and approved by the Program Director on behalf of the Steering Committee. Alberta will submit claims and will be reimbursed on a quarterly basis by Canada for those projects undertaken by Federal agencies and for the Canada share of jointly funded projects up to a limit of $2,000,000 in any one fiscal year. If any capital goods are purchased for a joint project, on the completion or otherwise termination of that project they may be sold or otherwise disposed of by mutual agreement, and any proceeds thereof divided pro rata between the parties.

(5) Salaries, travelling expenses and related costs of employees of the parties engaged in the Program and related committee duties shall not be paid from funds approved under this agreement except for salaries, travelling expenses and related costs of staff specifically assigned to or engaged in studies carried out on behalf of the Steering Committee by department or agencies of the parties.

(6) The salaries, travelling expenses and other costs incurred by Steering Committee members, their alternates and other government officials appointed to represent those party to the agreement on committees established or approved by the Steering Committee shall be paid for by their respective government.

(7) Where goods or services in respect of the Program (including, without limitation, equipment, office space or facilities specifically required for the Program) are provided by a party hereto or its agencies and are used or utilized by the other party or its agencies, any cost charged in respect thereto by the party or agency so providing shall be the actual cost to that last-mentioned party.

(8) As between the parties hereto, Alberta alone shall bear the responsibility for negotiating contributions to the Program by industry, to a level and upon such conditions deemed appropriate by the Ministers.

(9) Each party hereto shall, for audit purposes, keep appropriate records of expenditures made hereunder and, if requested by the other party, shall make available to the other party those records.

VI DURATION AND TERMINATION

For the purposes of this agreement, the term of the Program shall be five years, which said term may be renewed for a further period of up to five years. Either party may, however, at the end of any fiscal year during the currency hereof, terminate this agreement by giving to the other party by registered mail at least one clear year's notice thereof, it being agreed that no such notice may be given which would result in such termination prior to March 31, 1979.

VII. SCIENTIFIC INFORMATION PUBLICATION

The parties hereto acknowledge hereby that they are committed to the principle that scientific work performed as part of the Program may be published in appropriate journals and/or technical reports. Save as aforesaid, all information obtained in the Program shall be considered to be in the public domain.

VIII. NOTICES

Any notice to be given hereunder shall be addressed to the Provincial Minister or the Federal Minister, as the case may be, and shall be deemed to have been given upon the day it is received.

IX. GENERAL

No Member of Parliament shall hold or be admitted to any share or part of any contract, agreement or commission arising out of this agreement.

IN WITNESS WHEREOF the Honourable Romeo LeBlanc, Minister of the Environment, has hereunto set his hand on behalf of Canada, and the Honourable David J. Russell, Minister of the Environment of Alberta, has hereunto set his hand on behalf of Alberta.

In the Presence of:

_____

Signed on behalf of
Canada

_____
Date

In the Presence of:

_____

Signed on behalf of
Alberta

_____
Date

This agreement is hereby approved and ratified as a binding Intergovernmental Agreement of the Government of Alberta as evidence by the signature of the Minister of Federal and Intergovernmental Affairs.

_____
Minister of Federal and Intergovernmental
Affairs for Alberta

SCHEDULE "A"

GENERAL OBJECTIVE

To undertake environmental research relative to the renewable resources on the designated area which will make information available to the parties hereto to ensure an acceptable quality of the environment during and after operations for the recovery, transport, and processing of oil sands products. This research will be directed to the solution of practical social and technical environmental problems resulting from oil sands development.

SPECIFIC OBJECTIVES

1. To identify the baseline states, processes, and absorptive capacity of the biotic and abiotic resources that may be affected by oil sands development activities;
2. To identify the nature of interactions between the various components of the biotic and abiotic environment and the various components of proposed development activities;
3. To predict, in part from information obtained by meeting objectives (1) and (2), the individual and cumulative effects of anticipated developments on the biotic and abiotic environment;
4. To develop the methods necessary to protect the biotic and abiotic environment and finally return the biotic environment to a productive state;
5. To advise regulatory and management agencies and the industry of new scientific and technological information pertinent to their jurisdictions, to minimize adverse environmental effects and maximize beneficial environmental effects;
6. To use existing agencies within the administration of the parties hereto where possible and to use other sources when necessary. Taking inventories will not be considered as part of the objectives under this Program, except where necessary to provide research information;
7. To establish priorities in areas of research, and assign these priorities in the light of an Alberta development strategy for the oil sands;
8. To coordinate the projects within the Program so as to provide an interdisciplinary study of environmental problems;
9. To promote an environmental research program which will ensure cooperation among the governments of Alberta and Canada, industry, universities and other institutions.
10. To compile, assess, and disseminate research reports resulting from this Program.

SCHEDULE "B"

TERMS OF REFERENCE

The Program will be broad and comprehensive, except insofar as industry has the sole responsibility for detailed work on leased portions of the area and associated sites for installations or works, but it will not apply to any research and inventories concerning non-renewable resources in the area.

When research information is obtained under this program it shall be available to both parties.

Where Canada conducts research pursuant to those presents and incidentally obtains data respecting non-renewable resources, Canada shall provide Alberta with all such information and shall not use these data nor disclose them to anyone except with the written consent of the Provincial Minister.

SCHEDULE "C"

The area under consideration will be the lands comprised within

Townships 84 to 104, in Ranges 6 to 18 West of the Fourth Meridian, and Townships 105 to 115, in Ranges 6 to 9, excluding Wood Buffalo National Park in the Province of Alberta.

SCHEDULE "D"

SENIOR ADVISORY BOARD MEMBERSHIP

The following departments of Alberta and Canada shall be invited to membership on the Senior Advisory Board:

ALBERTA ENVIRONMENT

ENVIRONMENT CANADA

ALBERTA ENERGY AND NATURAL RESOURCES

ALBERTA RECREATION, PARKS AND WILDLIFE

NORTHEAST ALBERTA REGION COMMISSIONER

ALBERTA BUSINESS DEVELOPMENT AND TOURISM

CANADIAN INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

APPENDIX II

AOSERP-Industry Co-operative Model

18 May 1978

A SUGGESTED MODEL FOR ENVIRONMENTAL RESEARCH FUNDED JOINTLY BY AOSERP AND OIL SANDS INDUSTRY

This report develops a model for joint industry-AOSERP environmental research investigations. The model has been generalized to include any aspect of joint sponsorship of environmental research by a company and the Alberta Oil Sands Environmental Research Program.

Background:

In general, it is suggested that there is no need to consider joint sponsorship or funding of research where only a single interest (corporate or AOSERP) can be identified. In many cases, there will be minimal need for access to active company leases by AOSERP researchers, since much of the environmental research on such leases will be site-specific and clearly a company responsibility. However, reclamation research, studies on hydrogeology, toxicology, and others, may be more conveniently carried out on an active lease than elsewhere. In addition, there may be research projects involving air pollution and social impacts that obviously cross lease boundaries and which may be of interest jointly to leaseholders and to AOSERP.

It would appear convenient to develop an umbrella agreement acceptable both to AOSERP and to leaseholders under which terms may be negotiated for individual research projects where the joint interests of AOSERP and of the individual leaseholder can be satisfied most easily.

AOSERP Interests:

Relationship of research to AOSERP objectives - The objectives of the AOSER Program are approved by the governments of Canada and Alberta, under the amended Federal-Provincial agreement which received final signatures on 26 September 1977. Research sponsored by AOSERP must meet the objectives of the Program, under one of the Air, Land, Water, or Human Systems, as laid out in the policy document approved on 20 October 1977.

Research funded and carried out jointly with companies clearly must be of wide enough application that it is distinctly advantageous for the AOSER Program to be involved, or that lack of involvement would be a distinct disadvantage to the conduct of the Program.

Corporate Interests:

Corporate interests involve the need for the leaseholder to develop plans for reclamation, as well as for research on environmental effects of air and water pollutants. Because these efforts ultimately involve evaluation by regulatory agencies, it would seem appropriate to develop research investigations jointly with Government.

Because of the nature of operations on active leases, operating companies will need to exert control over physical access by and activities of researchers. Companies therefore require direct involvement in contracts with research contractors operating on their leases. Security and safety rules can only be enforced by the company itself.

Application and Availability of Research:

All research funded by AOSERP must be made public under the Federal-Provincial Agreement which provides the operating policy for the Program. For the purposes of this model, no environmental research data obtained under a joint AOSERP-industry project can be considered in any respect to be proprietary or confidential. All such research results will be published.

Jointly funded projects are intended to be of mutual advantage to AOSERP and the cooperating company, and all projects will be of a nature related to effects of oil sands development.

The Model:

The model suggested for AOSERP involvement in research with a company envisages joint sponsorship and funding. It would appear to be in the best interests of the company to contract directly with consultants, whether they be from a private firm, university, government research institutions or other.

In order to provide a legal basis for AOSERP involvement in funding, it is suggested that for each specific jointly funded project, AOSERP and the company negotiate terms which are mutually acceptable, and which provide a firm contractual obligation for both parties. The company would have control over physical access to leases by researchers, and would administer the projects.

Reports by consultants would be delivered simultaneously to the company and to Program Management for AOSERP. The contract between AOSERP and the company would specify the form of approvals required for acceptance of research reports. AOSERP would bear the cost of publication for 150 copies of reports as a contractual obligation to the company involved, at a scientific level acceptable to competent referees. Published reports would clearly indicate the joint sponsorship of the research work.

Research projects may be proposed for joint funding either by a company to AOSERP or by AOSERP to a company.

Policy Framework:

(1) No research project will be funded jointly if any part of it is based on data which are in any respect considered confidential by the company.

(2) No research project on an active company lease will be sponsored and/or funded by AOSERP if there is not joint sponsorship and/or funding by the leaseholder.

(3) AOSERP Research Managers will keep appropriate company contacts informed as to development of research plans in the Air, Land, Water and Human systems, in order that leaseholders will have ample opportunity to identify areas of research of mutual interest, and which might be proposed by company management as suitable for joint sponsorship. Companies will do the same.

(4) Research reports will deal only with scientific analyses and conclusions drawn therefrom. No statements concerning the results of research will be released until Program Management and the company involved have accepted

the research report and released it through the Steering Committee and senior company management. In the case of disagreement concerning release of a research report, either AOSERP or the company may release the report within 60 days of completion of the research report.

(5) A general agreement will be confirmed by exchange and joint signing of a memorandum of intent between a senior official of the company and the Chairman of the Steering Committee; individual projects will be carried out under contracts with specific and detailed terms of reference appropriate to the general agreement.

(6) Transmission of proposals for joint AOSERP-company research to a company from AOSERP or vice versa will be by exchange of letters between the Chairman of the Steering Committee for AOSERP and a senior official designated by the company.

(7) A working committee will be established for management of joint projects, with equal membership from AOSERP and the company.

Summary:

The suggested model and policy framework for cooperative research on active company leases sponsored and funded jointly by AOSERP and leaseholders is intended to prevent duplication of research effort and to provide better understanding of research needs and requirements for problem oriented research, both for oil sands companies and the AOSER Program.

It is anticipated that a significant proportion of Land System research on company leases of mutual interest to companies and AOSERP will be oriented to reclamation, and convenient to carry out as joint projects with operating companies. Research in Air and Water Systems generally will be of wide scope with some obvious involvements on leases which would be of high interest both for companies and for AOSERP. Human System research could take place on company leases, and joint AOSERP-company sponsorship of research in the Human System is likely to occur, both on and off leases.

APPENDIX III

Table 3 presents information on the status of AOSERP research reports for the fiscal years 1975-76, 1976-77, and 1977-78. Comments in the status column are coded as follows:

in preparation--the report is in preparation.

overdue--the report was not received by the due date.

late--the report was received after the due date.

in review--a draft or camera-ready report has been received and is in review.

in revision--the draft report and review comments have been returned to the author for revision of the report.

PM revision--the draft report is being revised by Program Management of AOSERP.

in press--the camera-ready report has been sent to be printed.

distributed--the published report has been distributed.

no report--a report is not required for this project.

no AOSERP report--AOSERP is supplying partial funding, but will not receive a report that is to be published as part of the AOSERP Research Report Series.

incorp. in XX 1.1 in 19XX-XX--the data collected during that fiscal year are to be included in a report for the project number and fiscal year noted. If no project number is given then the project number was the same in both years. If no fiscal year is given, then it refers to the same fiscal year.

admin. report only--the report to be received is for administrative use only and will not be published.

Table 3. Status of AOSERP research reports.

Fiscal Year	Project Number	Project Title	Contractor	Type of Report	Status
1975-76	ME 1.1	Meteorological Data Acquisition: Meteorological Tower	Atmospheric Environment Service	-	no report
	ME 1.2	Meteorological Data Acquisition: Meteorological Network	Atmospheric Environment Service	-	no report
	ME 1.3	Mobile Minisonde	Atmospheric Environment Service	-	no report
	ME 1.5.1	Meteorological and Air Quality Winter Field Study in the AOSERP Study Area, March 1976	Atmospheric Environment Service	Final	distributed
	ME 2.1	Air Quality Data Acquisition	Alberta Environment	-	no report
	ME 2.3.1	Plume Dispersion Measurements from an Oil Sands Extraction Plant	Intera Environmental Consultants	-	incorp. in 1976-77 report
	ME 3.3	Preliminary Investigations into the Magnitude of Fog Occurrence and Associated Problems in the Oil Sands Area	Stanley Associates Engineering	-	incorp. in 1976-77 report
	ME 4.0	Meteorology and Air Quality Simulation Modelling	-	-	no report
1976-77	ME 1.1	Meteorological Data Acquisition: Meteorological Tower	Atmospheric Environment Service	-	no report
	ME 1.2	Meteorological Data Acquisition: Meteorological Network	Atmospheric Environment Service	-	no report
	ME 1.3	Meteorological Data Acquisition: Mobile Minisonde	Atmospheric Environment Service	-	no report
	ME 1.4	Meteorological Data Acquisition: Precipitation Chemistry	Atmospheric Environment Service	-	no report
	ME 1.5.2	Meteorological and Air Quality Winter Field Study, February 1977	Atmospheric Environment Service	Final	late; in review
	ME 1.6	The Feasibility of a Weather Radar near Fort McMurray, Alberta	Alberta Research Council	Final	distributed
	ME 1.7	Very High Resolution Meteorological Satellite Study of Oil Sands Weather: "A Feasibility Study"	University of Alberta	Final	distributed
	ME 2.1	Air Quality Data Acquisition	Alberta Environment	-	no report

continued ...

Table 3. Continued.

Fiscal Year	Project Number	Project Title	Contractor	Type of Report	Status
1976-77 (cont.)	ME 2.2	Inventory of Sources and Emissions in the AOSERP Study Area	SNC Tottrup	-	Incorp. in 1977-78 report
	ME 2.3.1	Plume Dispersion Measurement from an Oil Sands Extraction Plant, March 1976	Intera Environmental Consultants	Final	distributed
	ME 3.3	Preliminary Investigation into the Magnitude of Fog Occurrence and Associated Problems in the Oil Sands Area	Stanley Associates Engineering	Final	distributed
	ME 3.4	Climatology of Low Level Air Trajectories in the Alberta Oil Sands Area	Acres Consulting Service	Final	distributed
	ME 3.5.1	Review of Pollutant Transformation Processes Relevant to the Alberta Oil Sands Area	University of Alberta	Final	distributed
	ME 3.5.2	Pollutant Transformation Processes	Atmospheric Environment Service	-	Incorp. in ME 1.5.2
	ME 3.8.1	Estimation of Dispersion Coefficients from Bivane measurements	Atmospheric Environment Service	Interim	late; in revision (some data to be included in ME 1.5.2
	ME 4.1	Calculations of Annual Averaged Sulphur Dioxide Concentrations at Ground Level in the AOSERP Study Area	Atmospheric Environment Service	Final	distributed
	ME 4.2.1	Review of Dispersion Models and Possible Applications in the Alberta Oil Sands Area	Atmospheric Environment Service	Final	PM revision

continued ...

Table 3. Continued.

Fiscal Year	Project Number	Project Title	Contractor	Type of Report	Status
1977-78	ME 1.0	Project Administration 1. Climatology of the AOSERP Study Area	Atmospheric Environment Service		
	ME 1.1	Meteorological Data Acquisition: Meteorological Tower	Atmospheric Environment Service	Interim	late; in review
	ME 1.2	Meteorological Data Acquisition: Meteorological Network	Atmospheric Environment Service		
	ME 1.3	Meteorological Data Acquisition: Mobile Minisonde	Atmospheric Environment Service		
	ME 1.4	Meteorological Data Acquisition: Precipitation Chemistry	Atmospheric Environment Service		
	ME 1.5.3	Meteorological and Air Quality Summer Field Study, June 1977	Atmospheric Environment Service	Final	overdue
	ME 2.1	Air Quality Data Acquisition Network 1. Air Quality of the AOSERP Study Area	Alberta Environment	Interim	distributed
	ME 2.2	Inventory of Sources and Emissions in the AOSERP Study Area	SNC Tottrup	Final	distributed
	ME 2.3.2	Plume Dispersion Measurements from an Oil Sands Extraction Plant	Intera Environmental Consultants	Final	in review
	ME 3.2	Background Air Quality in the AOSERP Study Area	Atmospheric Environment Service	Interim	overdue
	ME 3.5.2	SO_2 Oxidation in the Plumes from the GCOS Extraction Plant under Summer Conditions	Atmospheric Environment Service	Final	in review; to be incorp. in ME 1.5.3
	ME 3.5.4	Plume Chemical Reaction: Modelling and Verification	Hydrocarbon Research Centre, University of Alberta	Interim	in review
	ME 3.6	Literature Review on Pollution Deposition Processes	Acres Consulting Services	Final	in review
	ME 3.7	Low Temperature Fog Observations	Atmospheric Environment Service	-	incorp. in ME 1.0, 1.1, 1.2, 1.3, and 1.4

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Table 3. Continued.

Fiscal Year	Project Number	Project Title	Contractor	Type of Report	Status
1977-78 (cont.)	HE 3.8.3	Calculate Sigma Data for the Alberta Oil Sands Environmental Research Program Study Area	Intera Environmental Consultants	Final	in preparation
	HE 4.2.2	Air Quality Simulation Modelling	Atmospheric Environment Service	Interim	in review
1975-76	HE 1.1.1	Structure of a Traditional Baseline Data System	Population Research Lab., University of Alberta	-	incorp. in 1976-77 report
	HE 1.1.2	Development of a Theoretical Social Indicators Research Model: A Feasibility Study	Urban Research and Consulting	-	incorp. in 1976-77 report
	HE 2.1	Development of a Research Design Related to Archaeological Studies in the Athabasca Oil Sands Area	Dr. J.F.V. Millar	Final	distributed
	HE 2.2.1	Research Design for the Study of Social Problems and Social Preventive and Rehabilitation Measures within the AOSERP Study Area	Applied Research Associates	-	incorp. in 1976-77 report
	HE 2.3	Training and Employing Indigenous Workers: A Conceptual Scheme and a Proposal	Dev-Cor Technical Services	Final	in review
	HE 2.4	Athabasca Oil Sands Historical Research Project	J. Parker	-	incorp. in 1976-77 report
1976-77	HE 1.1.1	Structure of a Traditional Baseline Data System	Population Research Lab., University of Alberta	Final	distributed
	HE 1.1.2	Development of a Theoretical Social Indicators Research Model: A Feasibility Study	Urban Research and Consulting	Final	in review
	HE 1.2.1	The Impact of Resource Development on Individual and Family Well-being	Family Research and Consulting	Final	in review
	HE 1.2.6	An Exploratory Study of "Deviance" in the Athabasca Oil Sands Area	H. Johnson, M.S.W	Final	in review

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Table 3. Continued.

Fiscal Year	Project Number	Project Title	Contractor	Type of Report	Status
1976-77 (cont.)	HE 2.2.1	Research Design for the Study of Social Problems and Social Preventive and Rehabilitative Measures within the AOSERP Study Area	Applied Research Associates	Final	in review
	HE 2.2.2	Community Studies: Fort McMurray, Anzac, Fort MacKay	Applied Research Associates	-	incorp. in 1977-78 report
	HE 2.4	Athabasca Oil Sands Historical Research Project (3 volumes)	J. Parker	Final	in review; Vol. I on time, Vols. II and III late
1977-78	HE 2.2.2	Community Studies: Fort McMurray, Anzac, Fort MacKay	Applied Research Associates	Final	in review
	HE 2.5	Oral History of the Athabasca Oil Sands Region	Boreal Institute, University of Alberta	Interim	overdue
	HE 3.1	Longitudinal Study of Social Characteristics and Personal Adjustment in the Athabasca Oil Sands Region	Earl Berger Ltd.	Interim	overdue
	HE 4.1	Native Employment Patterns in the Athabasca Oil Sands Region	Canadian Institute for Research	Interim	in progress
1975-76	VE 2.0	Landscape Classification and Mapping	Reid, Collins and Associates	Final	PM revision
	VE 2.2	Preliminary Vegetation Survey of the Athabasca Oil Sands	Intraverda (Stringer)	Final	distributed
	VE 3.1	Symptomology of SO_2 Injury to Vegetation	Canadian Forest Service	Interim	PM revision
	VE 3.2	Threshold Level of SO_2 Injury to Vegetation	Canadian Forest Service	Interim	PM revision
	VE 3.3	Physiology and Mechanism of SO_2 Injury	Canadian Forest Service	Interim	PM revision

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Table 3. Continued.

Fiscal Year	Project Number	Project Title	Contractor	Type of Report	Status
1975-76 (cont.)	VE 3.4	Ecological Benchmarking and Bio-monitoring for SO_2 Effects on Vegetation and Soils	Canadian Forest Service	Interim	PM revision
	VE 4.1	Study of the General Properties and Reactions of Disturbed and Non-disturbed Soil Materials	University of Alberta	Interim	PM revision
	VE 4.2	Impact of SO_2 on Soils, and SO_2 Transformation in Soils	University of Alberta	Interim	PM revision
	VE 5.1	Literature Review of Peat	Alberta Research Council	Interim	Incorp. in VE 5.2
	VE 5.2	Characterization and Utilization of Peat in the Oil Sands Area	Alberta Research Council	Interim	PM revision
	VE 6.1	Long Term Prediction of Vegetation Performance of Dike Management	University of Alberta	Interim	In review
	VE 7.1	Reclamation for Afforestation by Suitable Native and Introduced Tree and Shrub Species	Alberta Forest Service	Interim	In review
	VE 7.2	Controlled Environmental Tests of Species Suitable for Revegetation	Alberta Agriculture	Interim	In review
	VE 7.3	Field Trials for Test Plant Communities	Alberta Agriculture	Interim	In review
	VE 7.4	Tests of Native Species for Oil Sands Reclamation	Alberta Agriculture	-	Incorp. in TF 1.1 in 1976-77
	TF 1.1.1	Ungulates	Alberta Recreation, Parks and Wildlife	-	Incorp. in TF 2.1 in 1976-77
	TF 1.1.2	Migratory Birds	Canadian Wildlife Service	Final	PM revision
	TF 1.1.4	Baseline Inventory: Furbearers 1. Furbearers Inventory in the Alberta Oil Sands Area 2. Analysis of Fur Production Records for Registered Traplines in the AOSERP Area, 1970-75	Alberta Recreation, Parks and Wildlife	Final	PM revision
	TF 1.1.5	Upland Birds Inventory	Alberta Recreation, Parks and Wildlife	-	Incorp. in TF 2.1 in 1976-77

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Table 3. Continued.

Fiscal Year	Project Number	Project Title	Contractor	Type of Report	Status
1975-76 (cont.)	TF 1.2	Endangered Species 1. Surveys of Rare Potentially Endangered and Sensitive Birds in the Oil Sands and Adjacent Areas of Northeastern Alberta	Canadian Wildlife Service	Interim	In review; incorp. in TF 2.2 and TF 2.3 in 1976-77
	TF 1.3	Recreational Use of Fish and Wildlife	IMPACT Environments	-	Incorp. in TF 6.1 in 1976-77
	TF 2.1	Winter Range and Wolf/Moose Hunting	Alberta Recreation, Parks and Wildlife	-	Incorp. in TF 1.1 in 1976-77
	TF 2.4	Adjustment of Trapping	University of Calgary	-	Incorp. in TF 6.2 in 1976-77
	TF 2.6	Intensified Wildlife Production	Alberta Recreation, Parks and Wildlife	-	Incorp. in TF 1.2 in 1976-77
	TF 3.1	Data Interpretation Co-ordinator	Alberta Recreation, Parks and Wildlife	-	no report
	TF 3.2	Bear - Human Interactions 1. A Selected Bibliography of Literature Pertaining to Black Bear Research and Management, 1975-76 2. A Preliminary Review of Black Bear-Human Interactions and Recommended Strategies for the AOSERP Study Area, 1975-76	Alberta Recreation, Parks and Wildlife	Final Final	PM revision PM revision
	TF 7.2	Data Interpretation and Application	IMPACT Environment	-	admin. report only
1976-77	VE 2.1	Soils Inventory of the Oil Sands Area	Alberta Research Council	Interim	PM revision
	VE 3.1	Symptomology and Threshold Levels of Air Pollutant Injury to Vegetation	Canadian Forest Service	Interim	PM revision

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Table 3. Continued.

Fiscal Year	Project Number	Project Title	Contractor	Type of Report	Status
1976-77 (cont.)	VE 3.2	Threshold Levels of SO_2 Injury	Canadian Forest Service	-	incorp. in VE 3.1
	VE 3.3	Physiology and Mechanisms of Airborne Pollutant Injury	Canadian Forest Service	Interim	PM revision
	VE 3.4	Ecological Benchmarking and Bio-monitoring for Detection of Airborne Pollutant Effects on Vegetation and Soils	Canadian Forest Service	Interim	PM revision
	VE 3.5	Air Pollution in the Athabasca Oil Sands: Effects on Vegetation, 1976; Reconnaissance Survey/Research Design and Development	University of Calgary	Final	no AOSERP report
	VE 4.1	1. Soils Research Related to Vegetation of the Oil Sands Area 2. Impact of SO_2 on Soils and Transformation (VE 4.2 in 1975-76 and 1977-78)	University of Alberta	Interim	PM revision
	VE 5.1	Literature Review of Peat	-	Interim	PM revision
	VE 5.2	Characterization and Utilization of Peat in the Oil Sands Area	Alberta Research Council	-	incorp. in VE 5.2
	VE 6.1	Long Term Prediction of Vegetation Performance of Dike Management	University of Alberta	Interim	PM revision
	VE 7.1	Reclamation for Afforestation by Suitable Native and Introduced Tree and Shrub Species	Alberta Forest Service	Interim	PM revision
	VE 7.1.1	Continued Monitoring of the Harmful Small Mammal Problem in the Alberta Oil Sands Reclamation and Revegetation Program	Canadian Wildlife Service	Final	no AOSERP report

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Table 3. Continued.

Fiscal Year	Project Number	Project Title	Contractor	Type of Report	Status
1976-77 (cont.)	VE 7.2	Controlled Environmental Tests of Species Suitable for Revegetation	Vaartnou and Sons Enterprises	Interim	distributed
	VE 7.3	Field Trials for Test Plant Communities	Vaartnou and Sons Enterprises		
	VE 7.4	Tests of Native Species for Oil Sands Reclamation	Vaartnou and Sons Enterprises		
	TF 1.1	Moose, Caribou, Wolf Ecology 1. Population Studies of Moose near Rochester, Alberta, 1976	Alberta Recreation, Parks and Wildlife	Interim	in review
		2. Wolf, Woodland Caribou, and Black Bear Population Dynamics in Northern Alberta		Interim	in review
		3. Dynamics of Moose Populations near Fort McMurray, Alberta, 1976		Interim	in review
		4. An Analysis of Moose Population Changes at Rochester, Alberta based on Ten Winters of Aerial Surveys, 1965-75		Final	in review
		5. A Review of Moose Habitat Requirements		Interim	in review
		6. A Census of Moose on Syncrude's Leases		Interim	in review
	TF 1.2	Relationship Between Habitat Strata, Forages and Carrying Capacity of Moose Range in the AOSERP Study Area	Alberta Recreation, Parks and Wildlife	Final	PH revision
	TF 1.3	Carnivores 1. Potential Productivity of Black Bear Habitat of the AOSERP Study Area	Alberta Recreation, Parks and Wildlife	Final	distributed
	TF 2.1	Avifauna Baseline Studies	Canadian Wildlife Service	Interim	in review
	TF 2.2	Rare and Sensitive Bird Species 1. A Preliminary Study of the Breeding Behaviour and Distribution of the White Pelican in the Alberta Oil Sands Area, 1976-77	Canadian Wildlife Service	Interim	in review
		2. Surveys of Rare Potentially Endangered and Sensitive Birds in the Oil Sands and Adjacent Areas of Northeastern Alberta		Interim	in review
	TF 3.1	Semi-aquatic Mammals (Beaver, Muskrat, Mink, and River Otter) 1. Semi-aquatic Mammal Studies, 1976-77	University of Guelph	Interm	in review
	TF 5.1	Amphibians and Reptiles 1. The Herpetofauna of the Alberta Oil Sands Region, 1975-76	University of Alberta	Interim	in review

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Table 3. Continued.

Fiscal Year	Project Number	Project Title	Contractor	Type of Report	Status
1976-77 (cont.)	TF 6.1	Determination of Current Consumptive and Non-consumptive Wildlife and Fisheries Resource Use. Socio-economic Evaluation of the Recreational Use of Fish and Wildlife Resources in Alberta with Particular Reference to the Athabasca Oil Sands Area, 1976-77	University of Alberta		
		Volume 1: Summary and Conclusions		Final	PM revision
		Volume 2: Recreation and Fishing		Final	PM revision
		Volume 3: Recreational Hunting		Final	PM revision
		Volume 4: Non-consumptive Recreational Use of Fish and Wildlife		Final	PM revision
	TF 6.2	Impact of Tar Sands Development on the Fur Industry	University of Calgary	-	incorp. in 1977-78 report
	TF 6.3	Integration of Remote Sensed and Field Acquired Information	University of Calgary	-	incorp. in 1977-78 report
	TF 7.1.1	The Fort McMurray AOSERP Moose Census: Analysis and Interpretation of Results, 1976-77	Interdisciplinary Systems	Final	PM revision
	TF 7.2	Data Interpretation and Application	Interdisciplinary Systems	-	no report
	TF 7.2.1	Application of Stratified Random Census Procedures to the 1976 Aerial Moose Census in the AOSERP Study Area	Interdisciplinary Systems	Final	distributed
1977-78	VE 2.1	Interim Report on a Soils Inventory in the Athabasca Oil Sands Area	Alberta Research Council	Interim	late; distributed
	VE 2.3.1	Ecological Habitat Mapping of the AOSERP Study Area: Phase I	INTERA Environmental	Interim	distributed
	VE 3.1	Symptomology and Threshold Levels of Air Pollutant Injury to Vegetation	Canadian Forest Service	Interim	late; in review

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Table 3. Continued.

Fiscal Year	Project Number	Project Title	Contractor	Type of Report	Status
1977-78 (cont.)	VE 3.3	Physiology and Mechanisms of Airborne Pollutant Injury	Canadian Forest Service	Interim	late; in review
	VE 3.4	Ecological Benchmarking and Biomonitoring for Detection of Airborne Pollutant Effects on Vegetation and Soils	Canadian Forest Service	Interim	late; in review
	VE 4.1	Soils Research Related to Vegetation of the Oil Sands Area	University of Alberta	Interim	late; in review
	VE 4.2	The Rate and Extent of Soil Changes Induced by Sulphur in the Oil Sands Area	University of Alberta	Interim	late; in review
	VE 5.2	Characterization and Utilization of Peat in the Oil Sands Area	Alberta Research Council	Interim	late; in review
	VE 6.1	Long Term Prediction of Vegetation Performance of Dike Management	University of Alberta	-	in preparation; overdue
	VE 7.1	Reclamation by Afforestation by Suitable Native and Introduced Tree and Shrub Species	Alberta Forest Service	Interim	late; in review
	VE 7.1.1	1. Control of Small Mammals on Reclamation Areas in the AOSERP Study Area: Literature Review and Problem Analysis	LGL Ltd.	Interim	late; in review
		2. Interim Report on Small Mammal Populations and Related Tree Damage in the AOSERP Study Area, October and November 1977		Interim	distributed
	VE 7.2	Controlled Environmental Tests of Species Suitable for Revegetation	Vaartnou and Sons Enterprises	Final	late; in review
	VE 7.3	Field Trials for Test Plant Communities	Vaartnou and Sons Enterprises	Final	late; in review
	VE 7.4	Technology of Seed Protection and Handling	Vaartnou and Sons Enterprises	Final	late; in review
	VE 9.1	Reinstatement of Biological Activity in Disturbed Soils and Mine Wastes	Research Secretariat	Interim	in review

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Table 3. Continued.

Fiscal Year	Project Number	Project Title	Contractor	Type of Report	Status
1977-78 (cont.)	TF 1.1	Moose, Caribou, Wolf Ecology 1. Woodland Caribou Population Dynamics on the AOSERP Study Area in Northeastern Alberta 2. Wolf Population Dynamics and Prey Relationships on the AOSERP Study Area in Northeastern Alberta 3. Dynamics of Moose Populations on the AOSERP Study Area in Northeastern Alberta 4. Dynamics of Moose Populations near Rochester, Alberta, 1977	Alberta Recreation, Parks and Wildlife	Interim	Incorp. in LS 21.1 in 1978-79
	TF 1.1.1	Analysis of the Moose Census and Associated Visibility Bias	Interdisciplinary Systems	Final	late; in review
	TF 1.4	Black Bear Ecology	Alberta Recreation, Parks and Wildlife	-	no AOSERP report
	TF 2.1	Avifauna Baseline Studies Volume I. Avifauna Baseline Studies, 1977-78 Volume II. Avifauna Baseline Studies, 1977-78	Canadian Wildlife Service	Final	Incorp. in LS 22.0 in 1978-79
	TF 2.2	Rare and Sensitive Bird Species: White Pelicans 1. Breeding Behaviour and Distribution of the White Pelican in the AOSERP Study Area 2. A Preliminary Study of the Distribution, Foraging Behaviour and Allied Activities of the White Pelican in the Alberta Oil Sands Area, 1977-78	Canadian Wildlife Service	Interim	Incorp. in LS 22.0 in 1978-79
	TF 2.3	Baseline States of Rare and Sensitive Species 1. Ecological and Behavioural Aspects of Breeding and Foraging Bald Eagles (Haliaeetus leucocephalus) in Northeastern Alberta 2. Survey of Rare, Potentially Endangered and Sensitive Birds in the Oil Sands and Adjacent Areas of Northeastern Alberta 3. Interim report on the Breeding and Foraging Ecology of Peregrine Falcons (Falco peregrinus anatum) in Northeastern Alberta	Canadian Wildlife Service	Interim	Incorp. in LS 22.0 in 1978-79

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Table 3. Continued.

Fiscal Year	Project Number	Project Title	Contractor	Type of Report	Status
1977-78 (cont.)	TF 3.1	Semi-aquatic Mammals (Beaver, Muskrat, Mink, River Otter) 1. Semi-aquatic Mammals	University of Guelph	Final	late; in revision
	TF 5.1	Amphibians and Reptiles	University of Alberta	Final	late; in review
	TF 6.2	Impact of Tar Sands Development on the Fur Industry 1. The Impact of Oil Sands Development on Trapping in the Fort McMurray Region, 1977-78	University of Calgary	Final	late; in review
	TF 6.3	The Application of Remote Sensing to Environmental Monitoring of the Athabasca Oil Sands Region, 2 Volumes, 1977-78	University of Calgary	Final	late; in revision
	TF 7.1	Integration of Habitat Typing Research	-	-	no report
	TF 7.2	Data Interpretation and Application	Dr. L. Carbyn	-	no report
	TF 8.1	Baseline Studies - Insect Fauna	Dr. A. Nimmo	-	in preparation
1975-76	AF 1.2.1	The Impact of Saline Waters upon Freshwater Biota (A Literature Review and Bibliography)	Aquatic Environments Ltd.	Final	distributed
	AF 2.1.1	A Survey of Baseline Levels of Contaminants in Aquatic Biota of the AOSERP Study Area	Freshwater Institute	Final	distributed
	AF 2.2.1	Life Cycles of some Common Aquatic Insects of the Athabasca River, Alberta	Freshwater Institute	Final	distributed
	AF 3.1.1	A Synopsis of the Physical and Biological Limnology and Fisheries Programs within the Alberta Oil Sands Area	Renewable Resources Consulting Services Ltd.	Final	distributed
	AF 3.1.2	A Synopsis of Information Relating to Aquatic Ecosystems Toxicology within the Alberta Oil Sands Area	Renewable Resources Consulting Services Ltd.	Final	distributed
	AF 4.1.1	Walleye and Goldeye Fisheries Investigations in the Peace-Athabasca Delta--1975	LGL Ltd.	Final	distributed
	AF 4.2.1	Development of Apparatus and Methods to Monitor Migration of Fish	Alberta Recreation, Parks and Wildlife	-	incorp. in AF 4.2.2 in 1976-77

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Table 3. Continued.

Fiscal Year	Project Number	Project Title	Contractor	Type of Report	Status
1975-76 (cont.)	HG 1.0	Regional Hydrogeology of the Athabasca Oil Sands	Alberta Research Council	-	looseleaf reports issued by ARC yearly
	HY 1.1	Interim Compilation of Stream Gauging Data to December 1976 for the Alberta Oil Sands Environmental Research Program	Water Survey of Canada	-	incorp. in 1976-77 report
	HY 2.3	Interactions of Humic Substances with Metallic Elements	Inland Water Directorate	-	incorp. in 1976-77 report
	HY 2.4	Low Flow Measurements	Alberta Research Council	Final	overdue
	HY 3.1	The Evaluation of Wastewater from an Oil Sand Extraction Plant	University of Calgary, Kananaskis	Final	distributed
1976-77	AF 1.1.2	Acute Lethality of Mine Depressurization Water on Trout Perch and Rainbow Trout	Alberta Environment	Interim	in review
	AF 1.5.1	Chemical Characteristics of Industrial Effluents	Chemex Labs	-	no report; co-operative with HY 3.1
	AF 2.0	An Interim Report on Ecological Studies on the Benthic Invertebrates of Rivers in the Alberta Oil Sands Environmental Research Program Study Area	R.R. Wallace	Interim	late; in review
	AF 2.3.1	Studies on Lake Acidification and Cycling of Heavy Metals in Aquatic Ecosystems	Freshwater Institute	Interim	late;in revision
	AF 2.5.1	Ecology and Life Cycles of Aquatic Invertebrates in Hartley Creek	University of Calgary	-	incorp. in 1977-78 report
	AF 3.2.1	Aquatic Environmental Toxicology Research Studies	Freshwater Institute	Final	in review
	AF 3.5.1	Acute and Chronic Toxicity of Vanadium in Fish	University of Guelph	-	incorp. in 1977-78 report
	AF 3.6.1	Multiple Toxicity of Nickel, Vanadium and Phenol to Fish	Concordia University	-	incorp. in 1977-78 report
	AF 4.2.2	Field Testing of Surgically Implanted Radio Tags in Fish (AF 4.2.1 in 1975-76)	Alberta Recreation, Parks and Wildlife	Final	in review

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Table 3. Continued.

Fiscal Year	Project Number	Project Title	Contractor	Type of Report	Status
1976-77 (cont.)	AF 4.3.2	Biological Sampling and Tagging of the Major Fish Species of the Athabasca River	Freshwater Institute and Alberta Recreation, Parks and Wildlife	Interim	late; in review
	AF 4.5.1	Interim Report on an Intensive Study of the Fish Fauna of the Muskeg River Watershed of Northeastern Alberta	Freshwater Institute	Interim	distributed
	AF 4.6.1	Recreational Use of Fish and Wildlife	Alberta Recreation, Parks and Wildlife	-	see TF 6.1
	HG 1.0	Regional Hydrogeology of the Athabasca Oil Sands	Alberta Research Council	-	looseleaf reports issued yearly by ARC
	HY 1.1	Interim Compilation of Stream Gauging Data to December 1976 for the Alberta Oil Sands Environmental Research Program	Water Survey of Canada	Interim	distributed
	HY 1.2	Additional Stream Gauging	Water Survey of Canada	-	no report
	HY 1.3	Suspended Sediment Data Collection at some Hydrometric Stations	Water Survey of Canada	Interim	late; in review
	HY 2.2	Lake Acidification Potential in the AOSERP Study Area	Freshwater Institute	Final	in review
	HY 2.3	Interaction of Humic Substances with Metallic Elements	Inland Water Directorate	Final	in revision
	HY 2.4	Heavy Metals in Bottom Sediments of the Mainstem Athabasca River System in the AOSERP Study Area	Canadian Centre for Inland Waters	Final	late; in press
	HY 2.5	Intensive Water Quality Study of the Muskeg River Basin	Alberta Environment	-	incorp. in 1977-78 report
	HY 2.6	Biochemical Ecology of the Athabasca River Related to Industrial Use	University of Calgary	Final	in review
	HY 3.1.1	Characterization of Organic Constituents in Waters and Wastewaters of the Athabasca Oil Sands Mining Area	University of Calgary, Kananaskis	Final	late; in review

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Table 3. Continued.

Fiscal Year	Project Number	Project Title	Contractor	Type of Report	Status
1977-78	AF 2.0.1	Invertebrate Resource Studies of the AOSERP Study Area	Freshwater Institute	Final	in review
	AF 2.0.2	Primary and Secondary Productivity Studies of Muskeg Drainage in the AOSERP Study Area	Freshwater Institute	Final	in review
	AF 2.3.1	Studies of Lake Acidification and Cycling of Heavy Metals in Aquatic Ecosystems	Freshwater Institute	Interim	overdue
	AF 2.5.1	Ecology and Life Cycles of Aquatic Invertebrates in Hartley Creek	University of Calgary	Final	late; in review
	AF 2.6.1	Assimilative Capacity of the Athabasca River due to Microbial Degradation of Organic Components	Chemical and Geological Labs	Interim	in review
	AF 3.5.1	Acute and Chronic Toxicity of Vanadium to Fish	University of Guelph	Final	in review
	AF 3.6.1	Multiple Toxicity of Nickel, Vanadium and Phenol to Fish	Concordia University	Final	overdue
	AF 4.3.2	Biological Sampling and Tagging of the Major Fish Species of the Athabasca River	Freshwater Institute	Interim	late; in revision
	AF 4.4.1	A Preliminary Study of Aquatic Habitat Mapping	Schultz International	Final	in review
	AF 4.5.1	Intensive Study of the Fish Fauna of the Muskeg River Watershed	Freshwater Institute	Final	late; in revision
	AF 4.5.2	Intensive Study of the Fish Fauna and Aquatic Habitat of the Steepbank River Watershed	Freshwater Institute	Final	in revision
	AF 4.8.1	Fisheries Investigation of the Athabasca and Clearwater Rivers Upstream from Fort McMurray	Aquatic Environments Ltd.	Final	in review
	AF 4.9.1	The Effects of Siltation on Aquatic Biota	Renewable Resources Consulting Services Ltd.	Final	distributed
	AF 4.9.2	Review of Stream Diversion and Stream Restoration Techniques and Associated Effects on Aquatic Biota	Envirocon	Final	in review

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Table 3. Concluded.

Fiscal Year	Project Number	Project Title	Contractor	Type of Report	Status
1977-78 (cont.)	HG 1.0	Regional Hydrogeology of the Athabasca Oil Sands	Alberta Research Council	-	looseleaf data reports issued yearly by ARC
	HG 1.1	Hydrogeological Investigation of the Muskeg River Basin	University of Alberta	Interim	in revision
	HY 1.1	Alberta Oil Sands Region Stream Gauging Data	Water Survey of Canada	Interim	late; in review
	HY 1.3	Suspended Sediment Data Collection of some Hydrometric Stations	Water Survey of Canada	Final	late; in review
	HY 1.4.3	Mixing Studies in the Athabasca River and Delta--Winter Conditions in the River	Alberta Research Council	Interim	in revision
	HY 2.5	Intensive Water Quality Study of the Muskeg River Basin	Alberta Environment	Final	overdue
	HY 2.8.1	Regional Water Quality of the Alberta Oil Sands Environmental Research Program Study Area	Alberta Environment	Interim	in revision
	HY 3.1.2	Water Quality Investigation into the Form of Organic Compounds in the Alberta Oil Sands Environmental Research Program (AOSERP) Study Area	University of Calgary, Kananaskis	Final	in review

AOSERP RESEARCH REPORTS

1.		AOSERP First Annual Report, 1975
2.	AF 4.1.1	Walleye and Goldeye Fisheries Investigations in the Peace-Athabasca Delta--1975
3.	HE 1.1.1	Structure of a Traditional Baseline Data System
4.	VE 2.2	A Preliminary Vegetation Survey of the Alberta Oil Sands Environmental Research Program Study Area
5.	HY 3.1	The Evaluation of Wastewaters from an Oil Sand Extraction Plant
6.		Housing for the North--The Stackwall System: construction report, Mildred Lake tank and pump house
7.	AF 3.1.1	A Synopsis of the Physical and Biological Limnology and Fishery Programs within the Alberta Oil Sands Area
8.	AF 1.2.1	The Impact of Saline Waters Upon Freshwater Biota (A Literature Review and Bibliography)
9.	ME 3.3	A Preliminary Investigation into the Magnitude of Fog Occurrence and Associated Problems in the Oil Sands Area
10.	HE 2.1	Development of a Research Design Related to Archaeological Studies in the Athabasca Oil Sands Area
11.	AF 2.2.1	Life Cycles of Some Common Aquatic Insects of the Athabasca River, Alberta
12.	ME 1.7	Very High Resolution Meteorological Satellite Study of Oil Sands Weather: "A Feasibility Study"
13.	ME 2.3.1	Plume Dispersion Measurements from an Oil Sands Extraction Plant, March 1976
14.	HE 2.4	Athabasca Oil Sands Historical Research Design (3 volumes)
15.	ME 3.4	A Climatology of Low Level Air Trajectories in the Alberta Oil Sands Area
16.	ME 1.6	The Feasibility of a Weather Radar near Fort McMurray, Alberta
17.	AF 2.1.1	Survey of Baseline Levels of Contaminants in Aquatic Biota of the AOSERP Study Area
18.	HY 1.1	Interim Compilation of Stream Gauging Data to December 1976 for the Alberta Oil Sands Environmental Research Program
19.	ME 4.1	Calculations of Annual Averaged Sulphur Dioxide Concentrations at Ground Level in the AOSERP Study Area
20.	HY 3.1.1	Characterization of Organic Constituents in Waters and Wastewaters of the Athabasca Oil Sands Mining Area
21.		AOSERP Second Annual Report, 1976-77
22.	HE 2.3	Maximization of Technical Training and Involvement of Area Manpower

23.	AF 1.1.2	Acute Lethality of Mine Depressurization Water on Trout Perch and Rainbow Trout
24.	ME 4.2.1	Review of Dispersion Models and Possible Applications in the Alberta Oil Sands Area
25.	ME 3.5.1	Review of Pollutant Transformation Processes Relevant to the Alberta Oil Sands Area
26.	AF 4.5.1	Interim Report on an Intensive Study of the Fish Fauna of the Muskeg River Watershed of Northeastern Alberta
27.	ME 1.5.1	Meteorology and Air Quality Winter Field Study in the AOSERP Study Area, March 1976
28.	VE 2.1	Interim Report on a Soils Inventory in the Athabasca Oil Sands Area
29.	ME 2.2	An Inventory System for Atmospheric Emissions in the AOSERP Study Area
30.	ME 2.1	Ambient Air Quality in the AOSERP Study Area, 1977
31.	VE 2.3	Ecological Habitat Mapping of the AOSERP Study Area: Phase I
32.		AOSERP Third Annual Report, 1977-78

These reports are not available upon request. For further information about availability and location of depositories, please contact:

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